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Research Using In Vivo Simulation of Meta-Organizational Shared Decision Making (SDM)

Task 2: Development of an experimental plan for in vivo exercise and simulation

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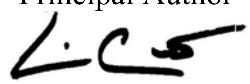

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Abstract

Introduction or background: This report represents Task 2 of the work stream "Research Using in Vivo Simulation of Meta-Organizational Shared Decision Making (SDM)", one component of the Technology Innovation Fund (TIF) program on Meta-organizational Collaboration that has been designed to assist in understanding challenges faced by the Canadian Forces (CF). The objective of the stream is to conduct basic research into shared decision making through the analysis of case studies, exercises and simulations.

Method: This task2 involved the development of an experimental plan to simulate an *in vivo* decision making environment of emergency management operations and to collect data on the problem solving processes and outcomes of participants in the simulation.

Results and Discussion: Based on the *Model for Inter-organizational Problem Solving* developed in Task 1, the experimental plan presents several research questions related to the impact that intra-organizational environment has on the ability to problem solve collaboratively, and, to the impact that collaboration has on improving problem solving outcomes and processes. The plan outlines two research components: 1) Qualitative analyses to identify features and cognitive structures/patterns that guide decisions about extreme events; 2) In vivo simulation of a complex event using a mix of organization types and participants.

Résumé

Introduction : Ce rapport présente la Tâche 2 du projet « Recherche par la simulation in-vivo sur la prise de décision partagée des méta-organisations », une composante du programme de recherche sur les méta-organisations financé par le Fond pour l'innovation technologique (Technology Innovation Fund – TIF), mis en place afin d'améliorer la compréhension des défis auxquels font face les Forces canadiennes (FC) en matière de collaboration inter-organisationnelle. L'objectif de ce projet est de mener une recherche fondamentale sur la prise de décision partagée, au moyen d'études de cas, d'exercices et de simulations.

Méthode : La Tâche 2 a impliqué le développement d'un plan expérimental afin de simuler un environnement sur la prise de décision partagée in-vivo des opérations de gestion des urgences et pour colliger des données portant sur les processus de résolution de problèmes et les performances des participants dans cette simulation.

Résultats et discussion : Basé sur le *Modèle pour la résolution inter-organisationnelle des problèmes*, développé en Tâche 1, le plan expérimental teste des questions de recherche liées à l'impact que l'environnement intra-organisationnel a sur la capacité de résoudre des problèmes en collaboration. Le plan décrit deux composantes de recherche : 1) Des analyses qualitatives afin d'identifier des caractéristiques et des structures ou modèles mentaux qui guident les décisions lors d'événements extrêmes; 2) La simulation in-vivo d'un événement extrême en utilisant des configurations particulières d'environnement selon les types d'organisations et de participants.

Executive summary

Research Using In Vivo Simulation of Meta-Organizational Shared Decision Making (SDM) - Task 2: Experimental Plan

Louise Lemyre[1] et al.; DRDC CSS CR 2011-31; Defence R&D Canada – CSS.

Introduction or background: This report describes the experimental research plan for Task 2 of the project entitled Research Using in Vivo Simulation of Meta-Organizational Shared Decision Making (SDM), one of the seven work streams of the Technology Innovation Fund (TIF) project that has been designed and implemented to assist in understanding and addressing the collaboration challenges faced by the Canadian Forces (CF). The CF has become increasingly involved in collaborating with various non-traditional partners to find and to implement solutions to address complex problems. Many complex problems faced do not have solutions that can be found within the CF doctrine and protocols. This gap has resulted in the CF working with organizations that may have different approaches to problem solving and decision making. Cooperation and collaboration present various challenges and opportunities to the CF such as identifying approaches that allow for deep, broad organization to organization collaboration, and integrating aspects of organizations while still maintaining individual organizational autonomy.

The objective of this specific stream is to conduct basic research into shared decision making through the analysis of case studies, exercises and simulations. In particular the research will provide recommendations for shared decision making within the context of the Incident Command System (ICS). The research approach will utilize a simulation system to examine the decision making processes of officials, responders and planners as they detect, prepare for and react to security threats and events.

Method: Headed by Dr. Lemyre, the Gap-Santé team at the University of Ottawa developed an experimental plan to test in vivo elements of the Model for Inter-organizational Problem Solving created under Task 1 of the project. The experiment aims to demonstrate that the Model when implemented in vivo can produce improvements in problem solving processes and outcomes such as better quality decisions, higher levels of satisfaction with problem solving processes, better time-to-satisfaction ratio and more cohesive multi-organization groups. The research strategy outlines an approach for conducting the study that includes two research components 1) Qualitative interviews and analyses; and, 2) In vivo simulation of shared decision making in a complex event. The qualitative interviews and analyses are meant to compliment the in vivo simulation component and will be integrated into the overall findings of the experiment.

Results: The research is designed to seek answers on the impact that intra-organizational environment has on the ability to problem solve in a collaborative manner and on the impact that collaboration has on the quality of problem solving outcomes and processes. For the qualitative interview component, approximately 20 interviews are planned with decision makers from a variety of organizations involved in one or more extreme events. Interviewees will be drawn from

[1] Dr. Lemyre is the McLaughlin Research Chair on Psychosocial Aspects of Risk and Health, Director of GAP-Santé at the Institute of Population Health, and Professor of Psychology, Faculty of Social Science, University of Ottawa

organizations that adhere to an Incident Command System (ICS) approach to planning and responding to extreme events, e.g., CF, RCMP, and from organizations that do not, e.g., community organizations, private sector. The interviews will be conducted using a semi-structured interview guide with a set of core questions and probes aimed to solicit past experiences and interpretations of the decision makers at various stages of problem solving during an identified extreme event. Analytic software will be used to classify, sort and arrange the qualitative information so that trends and patterns can be analysed.

The research design for the *in vivo* simulation component calls for the development of two sets of assessment tools to ensure that the study is properly implemented. One tool is needed to assess scenario complexity (i.e., simple, complicated, complex) and another to assess problem solving approach (i.e., independent, coordinated, cooperative, complex). (The conceptual underpinnings of these tools can be found in the Task 1 report.) The research design assumes a complex situation (control variable) within which decision makers have to undertake a number of tasks characterized as either "coordination" or "collaboration". Thus a number of scenarios will be developed and assessed for their degree of complexity, with the most appropriate one utilised in the experiment. Similarly, a number of coordination and collaboration tasks will be developed to initiate the problem solving process during the identified event. These will be assessed against a set of criteria that defines coordination and collaboration behaviours and the most appropriate tasks will be chosen.

The *in vivo* simulation design includes two independent variables – type of multi-organizational problem solving (i.e., coordination, collaboration); and, multi-organization environment. Participants will be drawn from three types of organizations (military, ICS non-military such as emergency services, and non-ICS such as non-governmental organizations) and grouped in pods (rooms) in a number of different ways for a session of the experiment. One session will hold nine participants grouped three to a pod. The experiment envisions eight sessions in total, with the initial set of four focusing on coordinating tasks and the second set focusing on collaborating tasks.

A complex scenario will be delivered to each pod via multi-media injects from a control room. The inter-pod and intra-pod interactions for each session of the experiment, prompted by task instructions, will be video and audio recorded. This will provide the source data for measurement of problem solving outcomes. The research design includes two sets of dependent variables – one focusing on problem solving processes and task or group cohesion, including individual, collective and panel satisfaction with the problem solving process; another focusing on problem solving outcomes such as decision quality and level of agreement on outcome. Various measures will be developed for each dependent variable (e.g., self reports, participant ratings, panel assessment, etc.). Once the dependent variable measures are finalized, an analysis plan will be created to guide the detailed descriptive and quantitative analyses. Findings will be documented and integrated with the findings from the qualitative analyses and interviews.

Next Steps: The next task of the project, *Using In Vivo Simulation of Meta-Organizational Shared Decision Making*, is the implementation of the experimental plan (Task 3). Final steps include the modelling of communication and decision making functions (Task4), and the development of a user friendly knowledge tool with recommendations (Task 5).

Sommaire

Recherche sur le partage de décision des méta-organisations en utilisant la simulation *in vivo* – Tâche 2 : Plan expérimental

Louise Lemyre[2] et al.; DRDC CSS CR2011-31; R & D pour la défense Canada – CSS; .

Introduction : Ce rapport présente les résultats découlant de la Tâche 2 du projet intitulé Recherche par la simulation in-vivo sur la prise de décision partagée des méta-organisations, un des sept chantiers du Fond pour l'innovation technologique (Technology Innovation Fund – TIF), un programme de recherche conçu et mis en place afin d'améliorer la compréhension des défis auxquels font face les Forces canadiennes (FC) en matière de collaboration inter-organisationnelle. Les FC collaborent de plus en plus avec de nombreux partenaires non traditionnels afin de trouver et de mettre en place des solutions pour faire face aux problèmes complexes. Les solutions à plusieurs des problèmes complexes rencontrés ne se trouvent pas parmi les doctrines et les protocoles des FC. Par conséquent, cela incite les FC à travailler avec des organisations qui utilisent différentes approches quant à la résolution de problèmes et à la prise de décisions. La coopération et la collaboration présentent de nombreux défis et opportunités pour les FC, tels que l'identification des approches qui permettent d'approfondir et d'élargir l'organisation de la collaboration entre les organisations et d'intégrer des aspects des organisations tout en maintenant l'autonomie de chacun.

L'objectif de ce champ spécifique est de mener une recherche fondamentale portant sur la prise de décision partagée au moyen d'études de cas, d'exercices et de simulations. Plus particulièrement, cette recherche vise à fournir des recommandations quant à la prise de décision partagée, dans un contexte de système de commandement des interventions (SCI). Le système de simulation sera l'approche utilisée pour examiner les processus de prise de décision partagée des autorités, des répondants et des responsables de la planification, à mesure que ceux-ci détectent, préparent et réagissent aux menaces à la sécurité et aux événements.

Méthode : Dirigée par la Professeure Lemyre, l'équipe Gap-Santé de l'Université d'Ottawa a développé un plan expérimental pour tester les éléments *in vivo* du *Modèle pour la résolution inter-organisationnelle des problèmes*, développé lors de la Tâche 1. L'expérience vise à démontrer que le *Modèle*, lorsqu'il est mis en œuvre *in vivo*, peut produire des améliorations quant au processus de la résolution de problèmes et ses résultats, tels qu'une meilleure qualité de décisions, un plus haut niveau de satisfaction quant au processus de la résolution de problèmes, un meilleur rapport temps-à-satisfaction, et des groupes multi-organisationnels plus unis. La stratégie de recherche présente une approche pour la réalisation d'une étude incluant deux volets de recherche : 1) des entrevues et analyses qualitatives et; 2) la simulation in vivo de la prise de décision pendant un événement complexe. Les entrevues et analyses qualitatives ont pour but de complémenter la composante de simulation *in vivo* et seront intégrées dans l'ensemble des résultats de l'expérience.

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[2] Dre. Lemyre est la titulaire de la Chaire de recherche McLaughlin sur le risque psychosocial, Directrice de GAP-Santé à l'Institut de santé des populations, et Professeure à l'École de psychologie, Faculté des sciences sociales, Université d'Ottawa.

Résultats : La recherche vise à mieux comprendre l'impact que l'environnement inter-organisationnel a sur la capacité de résoudre des problèmes d'une façon collaborative ainsi que l'impact que la collaboration a sur la qualité des résultats et les processus de la résolution de problèmes. Quant à la composante de l'entrevue qualitative, 20 entretiens sont prévus avec les décideurs d'une variété d'organisations impliquées dans un ou plusieurs événements extrêmes. Les personnes interrogées proviendront des organisations adhérant à une approche de Système de commandement des interventions (SCI) dans la planification et la réponse face à des événements extrêmes (par exemple, les FC, la GRC) et des organisations que n'y adhèrent pas (par exemple, des organisations communautaires, le secteur privé). Les entrevues seront effectuées en utilisant un guide d'entrevue semi-structurée avec une série de questions générales et des questions d'approfondissement dans le but de solliciter des expériences passées et les interprétation des décideurs à différents stades de la résolution de problèmes lors d'un événement extrême donné. Des logiciels d'analyse seront utilisés pour classifier, trier, et organiser les informations qualitatives afin d'analyser les tendances et les modèles émergeants.

La conception de la recherche pour la composante de simulation in vivo nécessite l'élaboration de deux ensembles d'outils d'évaluation pour s'assurer que l'étude soit correctement mise en œuvre. Un outil est nécessaire pour évaluer la complexité des scénarios (p.ex., simple, compliqué, complexe) et un autre pour évaluer l'approche de la résolution de problèmes (p.ex., indépendante, coordonnée, coopérative, complexe). (Les fondements conceptuels de ces outils peuvent être trouvés dans le rapport de la Tâche 1.) La conception de la recherche suppose une situation complexe (la variable contrôle) au sein de laquelle les décideurs ont à entreprendre un certain nombre de tâches caractérisées, soit par la « coordination » ou par la « collaboration ». Ainsi, un certain nombre de scénarios seront élaborés et évalués quant à leur degré de complexité, et le plus approprié sera utilisé dans l'expérience. De même, un certain nombre de tâches de coordination et de collaboration seront élaborées pour engager le processus de la prise de décision au cours de l'événement identifié. Celles-ci seront évaluées en fonction d'un ensemble de critères qui définissent la coordination et la collaboration des comportements, et les tâches les plus appropriées seront choisies.

Le devis de la simulation *in vivo* comporte deux variables indépendantes – le type de résolution de problèmes multi-organisationnels (p.ex., la coordination, la collaboration); et l'environnement multi-organisationnel. Les participants seront issus de trois types d'organisations (l'armée, les SCI non-militaires tels les services d'urgence et les non-SCI comme les groupes non-gouvernementaux) et regroupés en équipe (par pièce) de manières différentes pour chaque session de l'expérience. Une session comptera neuf participants regroupés en trois équipes. L'expérience prévoit huit séances au total, dont la première série de quatre portera sur la coordination et la deuxième sera axée sur la collaboration.

Un scénario complexe sera remis à chaque équipe via une assignation multi-média à partir d'une salle de contrôle. Les interactions inter-équipe et intra-équipe guidées par des instructions pour chaque session de l'expérience, seront enregistrées par voies vidéo et audio. Cela constituera la source de données pour l'évaluation des résultats de la résolution de problèmes. La conception de la recherche comprend deux ensembles de variables dépendantes - l'une axée sur les processus de résolution de problèmes et la cohésion de la tâche ou du groupe incluant la satisfaction individuelle, collective et d'un panel externe avec le processus de résolution de problèmes, l'autre mettant l'accent sur la résolution de problèmes tels que la qualité des résultats de la prise de décisions et le niveau d'accord sur le résultat. Diverses mesures seront élaborées pour chaque

variable dépendante (p.ex., les mesures auto-rapportées, les cotes des participants, l'évaluation par un panel, etc.) Lorsque les mesures des variables dépendantes seront finalisées, un plan d'analyse sera créé afin de guider l'analyse descriptive détaillée et quantitative. Les résultats seront documentés et intégrés aux résultats des entrevues qualitatives.

Prochaines étapes : La prochaine tâche du projet, *l'Utilisation de la simulation in vivo de la prise des décisions méta-organisationnelles*, est la mise à essai in vivo du cadre expérimental (Tâche 3). Les dernières étapes incluent la modélisation des fonctions de communication et de prise de décision (Tâche 4) et le développement d'outils de connaissance faciles à utiliser, accompagnés de recommandations (Tâche 5).

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Acknowledgements

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Preface

This document represents the final draft of *Task 2: Development of Experimental Plan for In Vivo Exercise and Simulation*, and is submitted using the DRDC supplied template for Contractor reports. The work has been completed for Defence Research and Development Canada (DRDC) as part of the contract deliverable defined in the project entitled *Research Using In-Vivo Simulation of Meta-Organizational Shared Decision Making (SDM)*, Contract No.: W7714-083659/001/SV. As per contract requirements, the document is provided in both electronic format and printed copy (5).

The document presents an overview of the research strategy, along with basic assumptions and guiding principles that will shape the conduct of the proposed study. These assumptions will need to be re-visited for currency as the study plan is implemented in Task 3 and adjustments made to the plan, if required. The plan conforms to best practice with its inclusion of research objectives and descriptions of each major study component, along with the methodologies to be employed. The plan also highlights the need to adhere to ethics approval processes and protocols for this type of research. While the thrust of the plan as detailed will remain the same, some specifics regarding the independent, control and dependent variables may change as further discussions ensue about the efficacy and efficiency of different options and approaches.

Document Distribution and Confidentiality

Document distribution and confidentiality protocols as specified in the contract noted above will apply to this document. Please contact Dr. Louise Lemyre, Principal Investigator, University of Ottawa, at louise.lemyre@uOttawa.ca should a change in protocols be requested. **Currently, this document is for the purview of the *Technical Authority*: DRDC and government only.** Please quote with due reference to Lemyre et al. 2010, Report on Research Using in Vivo Simulation of Meta-Organizational Shared Decision Making (SDM) – Task 2: Experimental Plan.

1 Introduction

1.1 Overview of the CORA TIF initiative

As outlined in an overview of the Centre for Operational Research and Analysis (CORA) and Technology Innovation Fund (TIF) of Defence Research and Development Canada (DRDC) (Chouinard, 2009), the Canadian Forces (CF) is finding that, as an organization, it is becoming increasingly involved with problems that defy easy solutions. Sometimes defined as "wicked problems"[3], these problems do not have solutions that can be found within the defined organizational doctrine or protocols of the CF. Given its role in assisting with these problems, the CF is increasingly working with numerous non-traditional partners. The CF and its partners find that they must not only cooperate and coordinate their activities, but that they must also collaborate in finding and contributing to suitable solutions. Often this collaboration requires deep, broad organization to organization collaboration. This level of collaboration presents various challenges (and opportunities) such as the integration of organizations while still maintaining individual organizational autonomy. The CORA TIF project, headed by Dr. Paul Chouinard, has been designed and implemented to assist in understanding and addressing these collaboration challenges.

1.1.1 CORA TIF project goal and work streams

The overall goal of the CORA TIF project is to:

"assist the Canadian Forces (CF) and partnering agencies through an understanding of inter-agency collaborative behaviour, the effects of inter-agency relationships on collective decision making and the influences of psycho-social factors. In addition, the research will seek to identify mechanisms for overcoming social and cognitive barriers to effective collaboration." (Chouinard, 2009, p. 2)

To meet this goal, there are seven work streams that are being implemented, one of which is the stream labelled *Using In Vivo Simulation of Meta-Organizational Shared Decision Making*. These are listed below.

1. Using In Vivo Simulation of Meta-Organizational Shared Decision Making

2. Improving Geographical Information Exchange through an Understanding of Agency Specific Cognition

3. Modelling Public Safety and Security Operations

4. Public Safety and Security Decision Making and Role of Professionalism

5. Applying Institutional Analysis to the Public Safety and Security Domain

6. Applying Economic Analysis to the Meta-Organization

7. Multi-Level Cultural Influences on Decision Making

[3] *Wicked problems* was a term originally coined in the late 1960's in operations research (Churchman, 1967), and early 1970's to describe problems related to social policy planning (Rittel & Webber, 1973). More recently, the term has been broadened to describe complex situations outside of planning and policy (Conklin, 2005).

1.1.2 Gap-Santé project goal and work stream

The objective of the work stream *Using In Vivo Simulation of Meta-Organizational Shared Decision Making* is to conduct basic research into shared decision making through the analysis of case studies, exercises and simulations. In particular, the research will provide recommendations for shared decision making within the context of the Incident Command System (ICS). The research approach will utilize a simulation system to examine the decision making processes of officials, responders and planners as they detect, prepare for and react to security threats and events.

1.2 Overview of project tasks

Within the GAP-Santé project work stream, there are five tasks. Each task is briefly described below.

1.2.1 Task 1: Synthesis of case studies to form a shared decision making (SDM) framework

This initial task entailed completing two independent lines of investigation. One line focused on reviewing various fields of literature including shared decision making and meta-organizational theories. The other line focused on developing case studies of inter-organizational decision making processes around extreme events that have occurred recently in Canada, and making some comparisons with international cases. The findings from these two lines were then integrated into a framework of meta-organizational shared decision making. The SDM framework, which is labelled a Model for Inter-Organizational Problem Solving, serves as the foundation for the future phases of the research. Refer to report entitled, *Research Using In Vivo Simulation of Meta-organizational Shared Decision Making (SDM) Task 1: Synthesis of Case Studies to form a SDM Framework,* (Lemyre et al., 2009) for details.

1.2.2 Task 2: Development of an experimental plan for in vivo exercise and simulation

This task involved the development of an experimental plan, as presented in this report, to simulate an *in vivo* decision making environment of emergency management operations and to collect data on the problem solving processes and outcomes of participants in the simulation. The experimental plan is designed for an *in vivo* decision making environment that is of a quality that is equal to or better than research done via the current Hydra simulation system. Refer to details on the Hydra system at the following site: http://www.liv.ac.uk/Psychology/ccir/hydra.html.

1.2.3 Task 3: Testing the shared decision making framework *in vivo*

From the results of Task 1, identify scenarios that challenge the SDM framework, as well as the ICS framework, if the latter differs from the SDM framework. These scenarios will be exercised within the simulated environment developed in Task 2. Participants in the simulations will include individuals from multiple levels of government, multiple jurisdictions and multiple disciplines according to the requirements of the particular scenario being exercised.

1.2.4 Task 4: Modeling communication and decision making functions

For Task 4, given the results of the laboratory findings, develop a model of the emergency management decision functions and the communications functions to support the decision function. The model of these functions must describe limitations and variations based upon situational factors described in the case studies. These situational factors must include circumstances where there is the potential for failure (e.g., the failure of the communications infrastructure during Hurricane Katrina). The functions must also be related to the SDM and ICS frameworks as well as activities described as elements of capabilities within the National Incident Management System (NIMS).

1.2.5 Task 5: Developing a user friendly knowledge tool

Provide guidance for the operational and the supporting analytic communities through a software-based, user friendly knowledge database tool based upon MS Access. The tool must provide these communities with access to the SDM framework recommendations for shared decision making, where there are differences between the SDM framework and the ICS framework, insight into the limitations of these frameworks, suggestions to overcome the limitations in what circumstances and any other insights that result from the research.

1.3 Purpose of present report

This report represents a draft of the work conducted under Task 2 of the project entitled Research Using in Vivo Simulation of Meta-Organizational Shared Decision Making (SDM) (Contract No.: W7714-083659/001/SV). It details the experimental plan for the in vivo exercise and simulation to be implemented under Task 3.

1.4 Overview of report sections

This document is organized into seven main sections with various sub-sections. The content for each of these sections is briefly described below.

SECTION 1 Introduction

- This section outlines the background of the CORA TIF project, its overarching goal and associated work streams. The objective of the work stream *Using In Vivo Simulation of Meta-Organizational Shared Decision Making* is stated and each of the five tasks associated with completing the work stream is described. The purpose of the document is stated along with a brief introduction to the content of the Task 2 report.

SECTION 2 Overview of Research Strategy

- This section begins with a number of research questions related to impacts that approaches to problem solving and multi-organizational environments have on problem solving processes and outcomes. It briefly describes the outcomes of Task 1 and their integration into the proposed experimental design. An approach to the study is presented and details on the two main components – *Qualitative Interviews* and *In Vivo Simulation Experiment*. The section

concludes with a brief discussion on the integration and synthesis process of the findings from the two research components.

SECTION 3 Methods for Component 1: Qualitative Interviews

- This section presents a rationale for the qualitative interview component of the study and highlights a number of strengths and challenges related to the proposed methodology.
- Details are provided on the selection process of extreme events, and on the selection and recruitment of interviewees.
- The interview process is described and an overview of the planned analysis is presented.

SECTION 4 Methods for Component 2: In Vivo Simulation Experiment

- This section provides an overview of the proposed experiment in terms of the choices made re: control, independent and dependent variables and type of study environment. A sample profile of a typical participant is provided to assist in the identification and selection of study participants.
- A key control variable, i.e., situation complexity, is discussed. Details are presented on the scenario development process utilizing factors that contribute to situation complexity, as outlined in the *Model for Inter-organizational Problem Solving*. Methods used to assess and validate the level of complexity of an event are presented.
- Independent variables are discussed as they relate to type of multi-organizational problem solving and multi-organization environment. Design principles for the problem solving tasks related to coordination and collaboration are presented, along with descriptions of their development and assessment processes. Details are provided on how members of different types of organizations will be grouped together into pods to simulate the multi-organizational environment. Also, session design details are discussed.
- Specifics on dependent variables are discussed related to both problem solving processes and outcomes. Study measures for the dependent variables are identified and discussed in terms of their validity, reliability and ease of use.
- The section concludes with a discussion of the descriptive and inferential research techniques that will inform the data analysis plan.

SECTION 5 Feasibility and Contingency Analysis

- This section highlights a series of issues that can significantly impact the conduct of the research study. These issues range from participant availability and study time requirements to technology utilized during the study and obtaining ethics approvals, among others. Contingencies are suggested to mitigate these identified risks.

SECTION 6 Implementation Next Steps

- This section provides details on the specific tasks to be performed in implementing both the qualitative interview component and the in vivo simulation experiment component of the study. For Component 1, these tasks include finalization of interview questions and process; obtaining ethics approval; recruitment of participants; testing of instruments and process; and launching of interviews. For Component 2, details cover tasks related to development and calibration of scenarios and injects; finalization of study measures and protocols; obtaining

ethics approval; control room and pod equipment set-up and testing; training of technical staff/observers/facilitators; and recruitment of subjects. A project schedule is provided with proposed start and end dates for these tasks.

SECTION 7 Application of findings and future considerations

- In this section implications are raised for training collaborative techniques in a multi-organization problem solving environment.
- This section also suggests opportunities for extending the research efforts beyond the experimental phase to include development of prototype training interventions compatible with an ICS structure and the testing of the prototype with various target groups. The development of additional scenarios related to international disasters (e.g., Haiti), "whole of government" events and/or community level collaborations is also discussed.

2 Overview of Research Strategy

This section presents an overview of the strategy that has been developed to guide the implementation of the two main research components for the *in vivo* simulation of meta-organizational shared decision making. Based on the model of multi-organizational problem solving developed during Task 1, the present research strategy outlines an approach to be used to better understand the consequences and impacts that implementing this type of model can have on various problem solving processes and outcomes. Details on each of the specific methods are presented in Sections 3 and 4.

2.1 Research objectives and questions

The overall research objective is stated as:

To better understand how problem solving processes and outcomes during complex, extreme events can be impacted by 1) the approaches used to problem-solve, and 2) the structure and governance of the multi-organizational environment.

Two specific research questions were derived from the overall research objective:

Q1: What effect does the approach to multi-organizational decision-making have on problem solving processes and outcomes?

Q2: What effect does the multi-organizational compositional environment have on problem solving processes and outcomes?

2.2 Overview of strategy

The starting point for the strategy is the *Model for Inter-Organizational Problem Solving* that was developed as part of Task 1 (see *Figure 1*). Within the iterative cycle of phases from problem awareness and identification, problem definition, solution generation, decision-making, solution implementation, feedback and solution evaluation (see *Figure 7* in *Annex A*), the model outlined how problem solving in a multi-organizational environment could optimally occur taking into account 1) Situation Complexity (i.e., simple, complicated, complex) (based on characterization of the situation as per *Figure 8* in *Annex A*), 2) Timeframe (from pre-event to post-event) (*Figure 9* in *Annex A*), 3) Asset sharing (power, information, resources (money, staff, equipment)) (*Figure 10* in *Annex A*), and 4) Approach to Problem Solving (i.e., independence, coordination, cooperation, collaboration) (*Figures 11 to 14* in *Annex A*).

As outlined in the research objective and questions above, the overall goal of the research at this stage is to demonstrate that the model when implemented *in vivo* can produce improvements in problem solving processes and outcomes such as better quality decisions, higher levels of satisfaction with problem solving processes, better time-to-satisfaction ratio and more cohesive multi-organization groups.

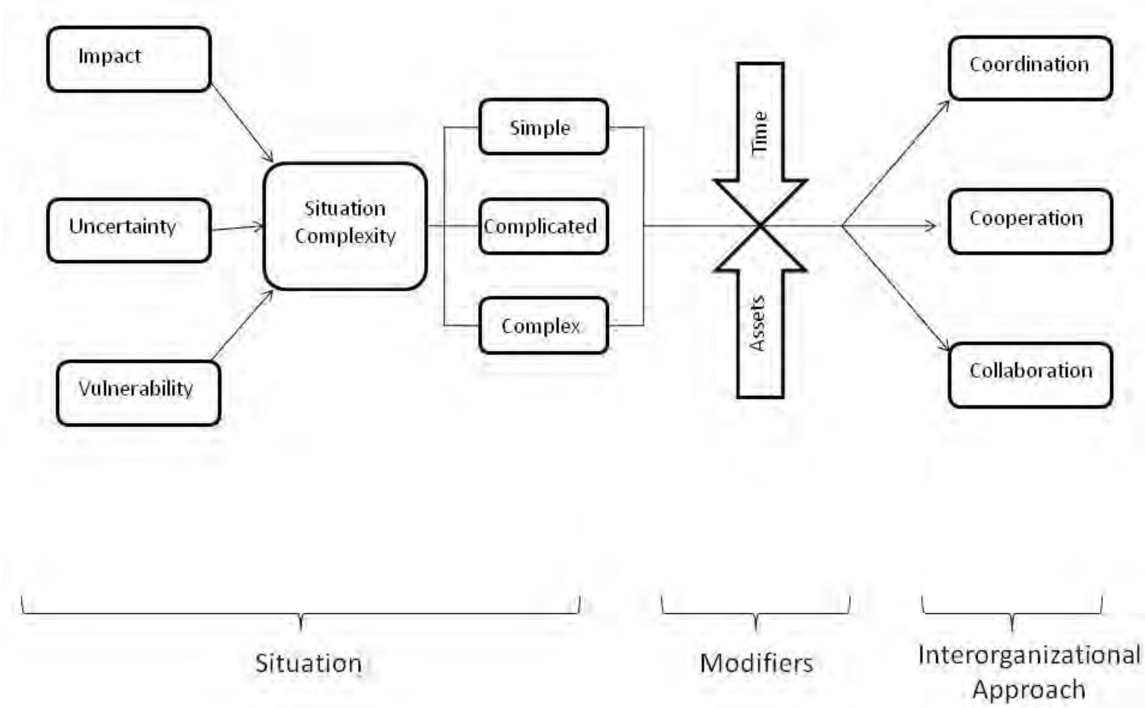


Figure 1: Generic model of inter-organizational problem-solving approaches as a function of situation complexity, assets of organizations and time phase.

As illustrated in Figure 2 below, there will be two main research components which will be implemented independently from one another. Component 1 focuses on improving understanding of the cognitive structures and patterns (or *mind maps*) that decision makers use to guide their actions during complex, extreme events. This will consist of conducting qualitative semi-structured interviews with approximately 20 individuals who have held decision making positions during recent extreme events. Component 2 consists of an *in vivo* simulation of a complex, extreme event using scenarios, injects, pods of participants and detailed tasks that have been designed to test the extent to which the model can produce better problem solving processes and outcomes. The findings from Component 1 will be used to assist in analysing and interpreting the data obtained from Component 2.

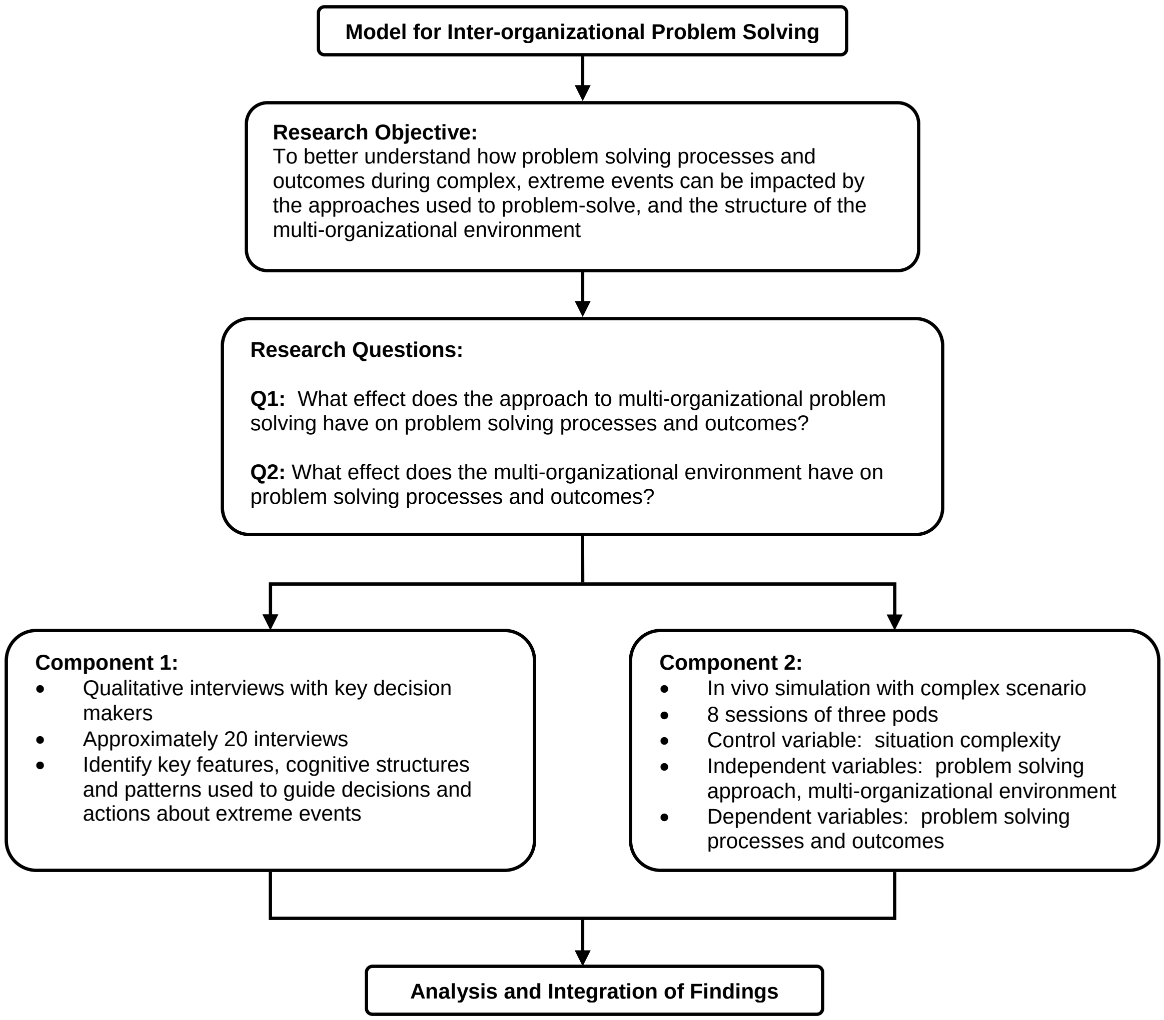


Figure 2: Overview of Research Strategy

2.2.1 Component 1 – Qualitative interviews with decision makers

The qualitative interviews are designed to elicit key cognitive structures and patterns that decision makers use to guide their actions during extreme events. The interviews will have respondents reflect on various stages of problem solving during an experienced complex, extreme event which involved multiple organizations. Using a semi-structured interview guide, the interviewer will ask the respondent to describe their various perceptions, understanding and experiences of how problem solving occurred during a Canadian extreme event (e.g., Ice Storm, SARS), and their involvement in these processes. In analysing the transcripts from these interviews, the team will attempt to identify common cognitive patterns and structures used by respondents. These will be compared and contrasted across different types of respondents, events, stages of problem solving, situation complexity, and organization type. These semi-structured, self-report methods produce data that allow the researcher to assess assumptions, frameworks and models employed by respondents (Klein et al., 1989). The analysis of interviews can provide a better understanding of context, expertise, and tacit knowledge of the respondents (Nja & Rake, 2009).

The interview process will use an adapted version of *Critical Decision Method* (Klein et al., 1989) as outlined by Smith and Dowell (2000). Interviewers will be guided by a semi-structured interview

guide developed specifically for this component. The guide will contain core questions designed to elicit responses on the main topic areas (e.g., problem solving approaches, situation complexity, decision outcomes) within the framework of *Critical Decision Method* which focuses on areas of incident identification, time-line and decision-point verification, derivation and connection of details, and alternative exploration. In addition to the core questions, follow-up probes will be designed to encourage the respondent to provide more detail, explanation, or interpretation, as required at the various stages. Overall, it anticipated that approximately 20 interviews will be conducted with each interview lasting approximately one hour.

Secondary source material, depending on availability, might also be considered for qualitative analysis. Anonymized transcripts of existing interviews and narratives on decisions may be analyzed using the grid developed for Component 1 and, in doing so, enriching the information-base with other historical experiences of decision-making during major events.

2.2.2 Component 2 – In vivo simulation experiment

The second research component will consist of an experimental study that has been designed to test the *Model for Inter-organizational Problem Solving*. The study environment will consist of three 3-person "pods" connected to one another and to a control room via video conferencing equipment. From the control room, the pods will be introduced to an evolving complex, major event scenario with various timed injects, and specific instructions and problem solving tasks that they are to undertake both within and between pods during the session. The independent variables that will be manipulated during the experiment include:

- Approach to problem solving:
  - two levels of approach to problem solving (coordinating, collaborating);
- Multi-organizational environment:
  - two levels of pod composition (same type of organization - homogeneous, mixed types of organization); and
  - two levels of inter-pod interaction (no interaction; open interaction)

The main dependent variables will be problem solving processes and outcomes such as decision quality, satisfaction with problem solving process according to actors and to external panel, task cohesion, participation, time and agreement.

Pods will be populated with individuals who have experience working at strategic and operational levels in planning for and responding to extreme events. Subjects will be recruited from various types of organizations including those that follow more of an incident command system (ICS) approach (e.g., military, police, emergency services), and those from organizations where an ICS approach is less typical (e.g., public health agencies, social services, financial institutions, community organizations). Eight sessions will be implemented, with nine participants per session. Sessions are expected to be approximately four hours in duration and will be audio- and video-recorded.

2.2.3 Integration of findings from components

The findings from the interview component using qualitative methods will complement the work that is being planned for the *in vivo* experiment component that relies primarily on quantitative methods. It is anticipated that by qualitatively understanding the key cognitive structures and

patterns that decision makers use to guide their actions in extreme event problem solving, the team will be able to use this information to assist in analysing and interpreting some of the findings derived from the *in vivo* experiment.

3 Methods for Component 1 – Qualitative Interviews

3.1 Overview of design

Qualitative research methods enable researchers to address research questions in a manner that is often complementary to using quantitative methods. While quantitative methods are often designed to test specific hypotheses and following strict assumptions, qualitative methods allow the researcher to elicit explanations, discover patterns, and understand relationships. Qualitative methods are often used to find answers that go beyond the scope of quantitative methods (Crotty, 1998; Smith, 2008). For the present study, findings from qualitative interviews will be used to assist in the analysis and interpretation of the data obtained from the more quantitative *in vivo* experimental component.

Interviews with key stakeholders are a retrospective method that can be used to study the decision making processes during emergency situations (Nja & Rake, 2009). For the present study, we will focus on the broader process of problem solving which includes decision making as one of the key stages. The overall approach for interviewing in the present study has been adapted from the *Critical Decision Method* approach to interviewing (Klein, Calderwood & MacGregor, 1989) which has been simplified and adapted by other authors (e.g, Smith and Dowell, 2000; Nja & Rake, 2009). Using a semi-structured interview guide with core questions and probes, the interviewer will work with the decision makers to elicit past experiences and interpretations at various stages of problem solving during an identified extreme event.

The main strengths of using this type of approach have been identified as:

- The analysis of qualitative data collected through semi-structured interviews can provide novel insights, perspectives and understanding of key constructs or concepts (Richards & Morse, 2007);
- Interviews with key decision makers can provide important information on context, expertise, and tacit knowledge required to effectively operate in extreme events that can be applied to multiple systems, settings and contexts (Nja & Rake, 2009; Klein et al., 1989); and
- Qualitative semi-structured interviews can be used to understand the cognitive structures and processes that decision makers use to guide their actions during extreme events (Klein et al, 1989).

Some of the key challenges to using this approach which have been considered in the development of the methods for this study include:

- Reliability of *a posteriori* accounts from those involved in events including retrospective distortions and faulty memories (Nja & Rake, 2009; Latiers & Jacques, 2009);
  - Our design will focus on events that have occurred within the past ten years, so that the recall will be easier than with events further in the past. Our emphasis will be on the interpretation of the event from their perspective in order to understand the cognitive structures and processes they likely used to guide their actions during the event. The goal is not to have a "factual" accounting of the event, but rather, an "interpreted" accounting of the event.
- Social desirability bias where respondents are more likely to present a positive image of themselves during the interview (Fisher, 1993);

    - This is less likely to be a concern given that the interviews will focus on interpretations of the event rather than qualitative judgements on appropriateness, quality of decisions, etc.
- Response burden for interviewees;
    - Given the time demands on the respondents, we will endeavour to limit the interview to approximately 60 minutes, and will travel to their workplace to conduct the interviews, if appropriate.

3.2 Selection of events and interviewees

Selection of extreme events

Three to four Canadian extreme events that have occurred within the past ten years will be selected from the case studies that were undertaken in Task 1 (e.g., SARS, Ice Storm). Selection of events will be undertaken in collaboration with DRDC, taking into account various considerations such as situation complexity, nature of event, and organizations involved, as well as pragmatic concerns such as accessibility and location of potential interviewees.

Selection of interviewees

Interviewees will be selected according to their association with the selected extreme events. In order to be considered for inclusion in the study, potential interviewees need to have had the authority to make key decisions on behalf of an organization that was present and be involved in the decision making process during the selected extreme event. We anticipate that these decision makers will be an excellent source of information regarding how situation complexity, approach to problem solving, and various mediating factors can impact on problem solving processes and outcomes.

The goal will be to recruit decision makers from a variety of organizations that were involved in one of a small number of extreme events. Within each event, there will be an attempt to recruit some decision makers from organizations that rely primarily on the Incident Command System (ICS) approach to planning for and responding to extreme events (e.g., CF, RCMP, EMO), and some from organizations that rely less on ICS approaches (e.g., community organizations, health authorities, private sector).

The anticipated number of interviewees required is around 20. This would include multiple interviewees from each selected event representing different stakeholders. This number would provide the study with rich, detailed data from interviewees representing different events and different organizations, and permit an analysis of data according to type of organization and event. A common standard for long, qualitative interviews is generally up to 10 people (Creswell, 1998). The rationale for substantially increasing this number is that the interviews are likely to be relatively short for this type of interviewing (approximately one hour) given the time demands on the interviewees, and the analysis plan requires examining patterns within and across sub-groups of interviewees (e.g., by organization type, by complexity of event).

Recruitment of interviewees

Recruitment will likely be challenging given the timing of the data collection (summer and fall), the relatively senior level of interviewees, and the number of interviews required. To mitigate the potential challenges, a flexible recruitment process will be developed with various stages and procedures outlined such as identifying potential interviewees, making initial contact, securing agreement to participate, scheduling, obtaining informed consent, and conducting the interview.

Another avenue to gather useful material will be to consider existing transcripts of relevant interviews and narratives about major events and decision-making. Given that the aim of a qualitative strategy is not to collect information in a systematic fashion but to gather insight into interpretation that will shed new light onto processes, the ad-hoc procedure of opportunistic analysis of existing material is fully legitimate. Hence we could use existing verbatims of key informants about significant events and transferred them into our grid of analysis.

3.3 Interview process

After securing ethics approval from the University Tri-Council Research Ethics Board, interviews will be conducted in-person by a trained interviewer using a semi-structured interview guide. Once informed consent has been achieved after the interviewer has briefly presented the purpose of the interview, the main foci, and general guidelines for the interview process (e.g., there are no right or wrong answers, ask for clarifications on questions), the process will begin by having the interviewee read through and sign a consent form. The interviewer will then use a semi-structured interview guide to ask the interviewee a number of open-ended questions and various follow-up probes that will be designed to elicit information on the main topic areas (e.g., problem solving approaches, situation complexity, decision outcomes and processes) (please refer to *Annex B* for examples of potential questions).

The overall goal of the interview will be to extract and understand the cognitive structures and processes, and schema, which guided the actions of the decision makers through various stages of problem solving during the extreme event. The interview will be an adaptation of the *Critical Decision Method* approach to interviewing which focuses on questions that bring out incident identification, time-line and decision- point verification, derivation and connection of details (*deepening*), and alternative exploration (*what if queries*). It is anticipated that the interview will start by having the interviewee provide an account of the event from his/her own experience. During the account, the interviewer tracks the main events, situation assessments, and decisions provided by the interviewee. The interviewer then reviews the account of the incident with the interviewee and asks follow-up questions or probes to elicit information on the main topics areas.

The interviews will last on average 60 minutes and be conducted at a location convenient for the interviewee (e.g., their office). All interviews will be audio-recorded so that they can be fully transcribed.

3.4 Analysis plan

The audio recordings from each interview will be fully transcribed. The verbatim transcripts will be imported into the *NVivo* program prior to analysis. *NVivo* is an analytic software program designed to assist with classifying, sorting and arranging qualitative information so that trends and patterns can be analysed.

Once the transcripts have been imported, the first step of the analysis will involve identifying sections of transcripts that are related to the perceptions of situation complexity (i.e., simple, complicated, complex). These sections will be screened and separated into meaningful units of information. The next stage of the analysis will involve analysing the identified units of information by expected themes (e.g., multi organizational environment, approach to problem solving, problem solving stage), as well as any emerging themes.

The analysis will rely extensively on the quality of data coding (i.e., assigning text or units of information to categories). Data coding will be conducted in a cascading manner. This means data

will be categorized initially into a small number of broad categories. The broad categories will then be coded into additional levels of subcategories as increased levels of specificity are required to support the analysis of themes. To measure the reliability of the coding scheme or categorizing system, once established, 10% of the interviews will be coded by two different researchers, and then the coding results compared. Where consensus does not exist, these aspects of the coding scheme will be re-examined and further refined or adjusted.

4 Methods for Component 2 – In Vivo Simulation Experiment

4.1 Overview of experiment design

4.1.1 Control, independent and dependent variables

The first stage of this project, *Task 1: Synthesis of Case Studies to form a SDM Framework*, identified a number of key variables for further study with respect to meta-organizational shared decision making. The control variable of situation complexity was selected to be complex, i.e. the experiment will focus only on a scenario that has been initially assessed as complex. Depending on the results of the planned study, future work may focus on converting situation complexity from a control variable to an independent variable to determine the extent to which event complexity has an impact on the problem solving processes. The two independent variables used in the experiment design are 1) approach to multi-organizational decision-making (coordination and collaboration), and 2) types of multi-organizational environments (homogeneous and mixed types of organizations). The dependent variables will include various measures of problem solving processes and outcomes.

4.1.2 Description of subjects/sample

Characteristics of subjects

Subjects recruited for the study will consist of decision makers who would normally be involved in the response to extreme events on behalf of their organizations. They will be recruited from various sectors and types of organizations including public, private and non-governmental organizations normally involved in planning for, responding to and/or managing complex, extreme events at the municipal, regional or national level.

It is anticipated that the higher the level of decision makers in the sample, the more persuasive will be the results. Subjects must have the authority and experience to make both strategic and operational decisions during an emergency situation. Therefore, subject recruitment will focus on finding appropriate subjects who are higher-level decision makers and who fit the inclusion / exclusion criteria outlined in *Table 2.* As senior level decision makers, these participants during extreme events would normally assume roles and responsibilities that are particular to their level of influence and expertise. For example, military captains and majors, chiefs and coordinators of emergency services, executive officers of interested business associations and non-governmental organizations would all make ideal candidates.

In order to replicate the convergence that occurs on the scene of an extreme event, subjects will be selected from different sectors and organization types. The participants will be coming from a number of sectors, including subjects from the military, other organizations that use employ an ICS structure, and organizations that use alternative organizational structures. By recruiting subjects from both ICS and non-ICS organizations, the impact of organizational structures on decision making can be measured. Additionally, the study of subjects from different sectors and organization types makes it possible to measure differences in problem solving among different workplace cultures, providing further insight into the relationship between problem solving and multi-organizational contexts.

One step in finalizing the sampling plan will be to identify specific key organizations from which to recruit participants. At this point in the planning , we have identified six ke y sectors, and examples of the types of organizations that could be approached (see Table below for examples). The specific organizations selected classification of organizatio n type and distribution of participants across organizations will be finalized in the sampling plan to be discussed with CSS as part of Task 3.

Table 1: Key sectors and example organizations

Sector/Type of Organization	**Example Organizations**
Military	• Maritime Command • Land Force Command • Air Command
Other Federal Government Departments and Agencies	• Canadian Nuclear Safety Commission • Public Health Agency of Canada • Public Safety • Royal Canadian Mounted Police • Transport Canada
Provincial Government Departments and Agencies	• Emergency Measures Organizations (EMO's) • Health ministries • Provincial police forces • Environment ministries
Regional Government Departments and Agencies	• City officials • Emergency operations centres (EOC's) • Fire departments • Police departments
Non-Governmental Organizations and Associations	• Canadian Red Cross • Community organizations • St. John Ambulance • The Salvation Army
Private Sector Organizations and Associations	• Business associations • Information management organizations

Screening criteria

Once the specific organizations have been selected, a screening process will be undertaken to ensure that the individuals invited t o participate from each organization correspond to t he recruitment profile of higher-level decision makers within thei r respective organizations. The selection process for individual subjects will rely on specific criteria in order to ensure that subjects participating have similar levels of decision-making authority in their respective organizations, and have some experience with planni ng for, responding to an d/or managing extreme events. The specific inclusion and exclusion criteria for screening of individuals are presented in *Table 2*.

Table 2: Inclusion and exclusion criteria for selecting participants

Inclusion Criteria
1. Previous experience in both strategic and operational decision-making during at least one major event (not necessarily with current organization)
2. Have been in a management-level decision making role for his/her organization for at least 12 continuous months
3. Has the authority to make decisions regarding allocation of resources (human, financial and equipment) on behalf of their organization (or region) with respect to major events
4. Able and willing to volunteer to participate in study
Exclusion Criteria
5. Outside commuting distance of a study site
6. Unable to effectively communicate in the official language of the study session

4.1.3 Description of study environment and processes

This section describes the study environment, information flows and processes needed to conduct the experiment.

4.1.3.1 Facility requirements

A control room and three separate rooms for the pods are needed to run each session of the experiment. The control room will be used to transmit the initial scenario to the pods and to provide instructional tasks and informational injects to advance the simulation. It will also be used to observe the occupants of the pods and to audio- and video-record the events within each pod. Each pod will consist of three study participants. Refer to section *4.2.3 Multi-organization environment* for detailed information on individual pod composition. The control room and pod rooms will be in one physical location.

The pod rooms will be identical as much as possible in terms of equipment and physical layout. Each pod room will have three online conferencing stations, web cameras, a printer, three headsets with earphones and microphones, white board, three chairs, a table in the center for discussions, pens, markers and other assorted stationary. There will be a monitor either mounted to the wall directly in front of the table or sitting on one end of the table. This monitor will be linked to one of the computers so that participants will be able to maximize their use of the conferencing soft ware, when made available to the pods.

The control room will serve as the nerve centre for the session. In addition to recording and moderating the online conference, the control room will video and audio-record the participants in

each pod, collect the data generated from the injects, and feed all the critical information to the pod members, i.e., the scenario injects and tasks. The control room will also run the online conference for an initial virtual introductory session and the debriefing at the end of the simulation. Contained inside the control room will be a table, conferencing computer, monitor, headset and three monitors to observe the video feeds.

4.1.3.2 Information flows and processes

Study subjects will be able to communicate interpersonally with each other in their own pod given they are in the same room. Conversations between individuals will be recorded and the entire session will be videotaped. In addition, each subject will be provided information and the tools needed to communicate with members from the other two pods in the session during specific periods of the session. The figure below illustrates the paths of communication between the control room and the pod rooms. It also illustrates the medium used to capture communication between and within the pod rooms.

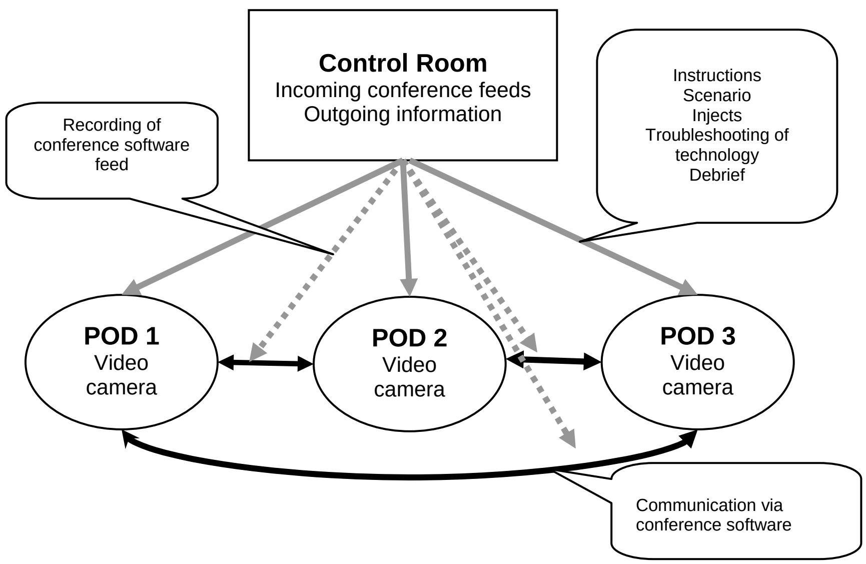


Figure 3: Communication paths in session design

The configuration as outlined in *Figure 3* requires two types of communication: uni-directional and bi-directional.

1. *Uni-directional communication.* In this form of communication, information is sent from the control room to the pod rooms. Information injects and tasks can be read and evaluated by the pod members, but cannot be changed. The control room will not provide clarification or further information based upon pod requests. This approach will mimic the traditional uni-directional communication methods often used in complex, extreme events, such as television, radio reports, phone messages, fax and memos. Uni-directional communication will also be employed by the control room for the collection of data from pod rooms and individual pod members. Video, audio and written data will be collected for examination. These different methods of observation will provide data for the analysis of the collaborative effort and the problem solving processes and outcomes, as well as provide a time stamp with which to mark and compare all actions that take place in and between the pods.

2. *Bi-directional communication.* Information will be shared, discussed and exchanged within the pods (herein referred to as intra-pod) using traditional information sharing techniques. These methods include verbal and written communication between pod members. Information may also need to be shared between some or all of the pods (inter-pod).

   For inter-pod communication alternative methods of collaboration need to be employed. Subjects may need or want to communicate with one another inter-pod. Indeed, that is the hope and the aim of the task with which they are being presented during two of the four overall periods within each session. They will need to hear what others are thinking and see what problem definition/problem solving they are proposing. During two periods of each session, pod members will need to be able to have input or at least understanding and consensus with the decisions being made in the other pods. To this end, each pod member will have their own computer and be able to join a group meeting or start new private meetings with other participants.

To efficiently achieve both uni- and bi-directional communication, online conferencing software will be employed. Using online conferencing software will allow for information to be passed from the control rooms to the pod rooms in a uni-directional manner and collect data from each pod room, while simultaneously allowing the pods to communicate with one another.

With the online conferencing software, the control room will be able to transmit injects and tasks to the pod rooms through:

1. Video in the form of prefabricated ‘news reports’, directly through video conferencing or even through video emails sent to the pod rooms;

2. Audio radio broadcasts, phone messages and other traditional forms of verbal communication; and,

3. Text presentation simulating fax and reporting as well as email and real time chat conferencing.

Conferencing software will also serve as a conduit for inter-pod communication. Subjects will be given a simple video tutorial explaining the basic features of the conferencing software. Participants will be able to use video chat, audio, instant message and email conference features.

In order to ensure that both quantitative and qualitative information is collected, the control room will record and collect data using both the conferencing software and standard recording equipment. Online conferencing information will be collected through the conferencing software. Each meeting will be recorded in a screen capture video and notes and written conversations will be collected from any online meetings. The recorded digital minutes of the meeting will include all video and audio from any online meetings as well as all chat and email messaging. An additional benefit to this method is that all decisions made in the conference environment will be automatically timed stamped. This will help to understand the nature of the decision making and collaborative behaviours employed by the various pods in all the different runs of the experiment. As a redundant measure to further guarantee the safe collection of data and to capture the intra-pod actions conducted outside of the web conference, a video camera will be filming from each pod-room ceiling to audio and video record events in each pod room.

The pods may need or want to perform research into the problems they are trying to solve. As a result, each machine will be equipped with internet access, and be loaded with Microsoft Office to perform as a traditional work station in addition to serving as a conferencing point. A printer will be available in each pod room and will be linked to each computer.

A virtual briefing/debriefing room will be used at the beginning and end of each session. This virtual room will be an online conference that will be configured identically across sessions. This meeting will serve three functions:

1. It will introduce the study process and 'rules of engagement' to the pod participants. (Note: since it will be difficult if not impossible to gather all the required participants in one geographical centre, the pod rooms will be set up in different locations, as required.)

2. It will provide a basic video tutorial on using the online conferencing software and answer any questions pertaining to the software and its proper execution.

3. After the completion of the experiment, participants will rejoin the virtual meeting room for the purposes of debriefing.

4.2 Control Variable

In order to have a rigorous experiment design, it is important to control as many potentially influential variables as possible. There are various control variables in the current design such as controlling for subjects' levels of authority in their organizations, pod size, introduction/briefing statements, length of session, etc. While many of these have been identified and their control has been built into the design, the control variable of greatest importance is *situation complexity*. According to the *Model for Inter-Organizational Problem Solving* developed in Task 1, situation complexity modified by assets and time results in different approaches to problem solving. Taking into consideration the objectives for the current study as well as the time and resources allocated, the decision was made to focus solely on complex situations, therefore controlling situation complexity at the *complex* level. Depending on this study's results, future work could include converting situation complexity from a control variable to an independent variable to determine the impact that different levels of complexity have on the problem solving process. The current study will result in tested tools to assess situation complexity. These tools could then easily be used in future work to develop/assess scenarios according to various levels of complexity.

4.2.1 Control variable: Situation complexity

The experiment is designed to measure the extent to which 1) approach to multi-organizational decision-making; and 2) types of multi-organizational environments impact on problem solving processes and outcomes during complex major events. As a result, the study design must be able to hold constant the control variable of *situation complexity*, while manipulating the approaches used to problem solve, and the types of multi-organizational environments. Considerable effort will be made to ensure that situation complexity is held constant at the complex level within and across sessions.

Situation complexity will be held constant by employing within each session the same *in vivo* scenario carefully developed and thoroughly assessed as representing a complex, extreme situation. The scenario will be presented to the pods and evolve throughout the testing session through a series of injects delivered from the control room to each pod. The overall process will be similar to that of a functional exercise, a method frequently used for training and planning for extreme events (FEMA, 2003).

4.2.1.1 Description of scenario development process

As per best practice guidelines for development of similar types of exercises (FEMA, 2003), the study will require an overall complex master scenario of events, accompanied by highly detailed messages and injects to ensure that the *in vivo* situation remains complex throughout the testing session. To ensure that the scenario is realistic, the development process will consider the authority required for making decisions, experience levels of participants, resources available for the various organizations involved, and the time period to be simulated, including message flow and the passage of time, also known as skip time. In section *6.0 Implementation: Next Steps*, references are made to the specific steps required to develop these various components.

The *in vivo* aspect of the study will require that the scenario has a believable narrative to guide participants through an extreme event, compressing the simulation into approximately four hours. This four hour block would include the brief training on conferencing software, briefing/debriefing sessions and transitions. In addition, to contribute to the *in vivo* simulation aspect of the study, scenario-based messages and injects will be delivered via several communication routes including: video news flashes, text messages, etc.

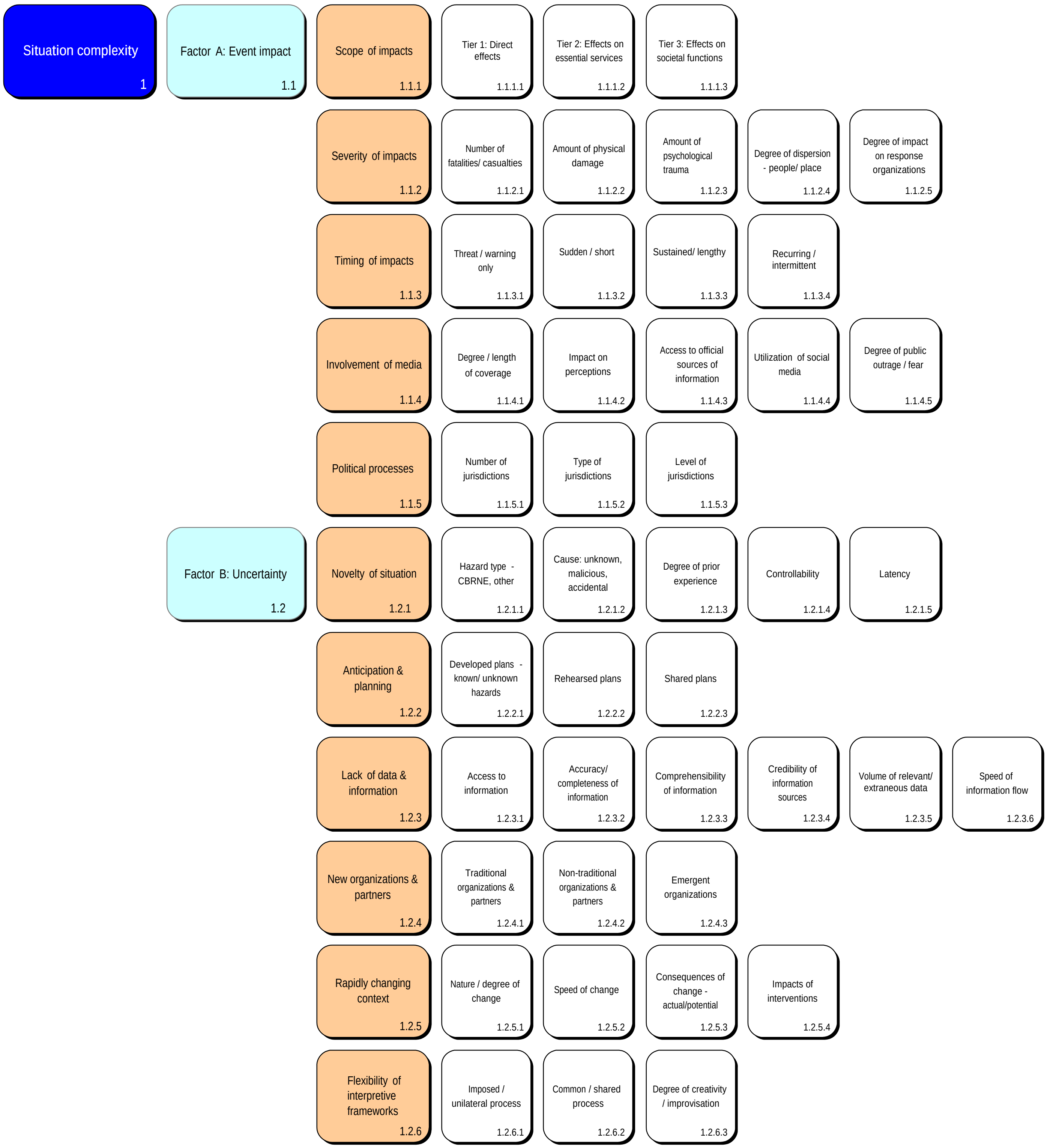
In order to ensure that the measurable level of situation complexity is at the *complex* level, the research team will apply the criteria of the *Model for Inter-Organizational Problem Solving* outlined in Task 1 of the project (Lemyre et al., 2009). The *Model* outlines three key factors contributing to situation complexity: **(a) Event Impact**, **(b) Uncertainty**, and **(c) Vulnerability**. Contributing to each of these factors are various elements:

- **Factor A: Event Impact** is shaped by the elements of impact scope, impact severity and impact timing, as well as media involvement and political processes.

- **Factor B: Uncertainty** is shaped by the elements of novelty of the situation, knowledge about the hazard, degree of prior planning, availability of information, flexibility in interpreting the situation using multiple perspectives, presence of new organizations and the speed at which the context changes.

- **Factor C: Vulnerability** is shaped by the elements of: levels and diversity of social characteristics of the populations involved, of economic standing, existence of social capital and community competence, type and quality of information sources and of communication networks, and functional characteristics on the critical infrastructure.

To structure the scenario and ensure that all key factors, elements and potential sub-elements are considered in development, the team has developed a grid that provides the key elements contributing to each of these factors (see Figure 4). By following this grid in a systematic manner, and, where appropriate, emphasizing the complex end of dimensions, the team will develop and assess scenarios to ensure that an appropriate level of complexity is achieved and maintained through the session. (*Refer to Figure 4* for *Template scenario elements grid*).


Situation complexity 1
Factor A: Event impact 1.1
Scope of impacts 1.1.1
Tier 1: Direct effects 1.1.1.1
Tier 2: Effects on essential services 1.1.1.2
Tier 3: Effects on societal functions 1.1.1.3
Severity of impacts 1.1.2
Number of fatalities/ casualties 1.1.2.1
Amount of physical damage 1.1.2.2
Amount of psychological trauma 1.1.2.3
Degree of dispersion - people/ place 1.1.2.4
Degree of impact on response organizations 1.1.2.5
Timing of impacts 1.1.3
Threat / warning only 1.1.3.1
Sudden / short 1.1.3.2
Sustained/ lengthy 1.1.3.3
Recurring / intermittent 1.1.3.4
Involvement of media 1.1.4
Degree / length of coverage 1.1.4.1
Impact on perceptions 1.1.4.2
Access to official sources of information 1.1.4.3
Utilization of social media 1.1.4.4
Degree of public outrage / fear 1.1.4.5
Political processes 1.1.5
Number of jurisdictions 1.1.5.1
Type of jurisdictions 1.1.5.2
Level of jurisdictions 1.1.5.3
Factor B: Uncertainty 1.2
Novelty of situation 1.2.1
Hazard type - CBRNE, other 1.2.1.1
Cause: unknown, malicious, accidental 1.2.1.2
Degree of prior experience 1.2.1.3
Controllability 1.2.1.4
Latency 1.2.1.5
Anticipation & planning 1.2.2
Developed plans - known/ unknown hazards 1.2.2.1
Rehearsed plans 1.2.2.2
Shared plans 1.2.2.3
Lack of data & information 1.2.3
Access to information 1.2.3.1
Accuracy/ completeness of information 1.2.3.2
Comprehensibility of information 1.2.3.3
Credibility of information sources 1.2.3.4
Volume of relevant/ extraneous data 1.2.3.5
Speed of information flow 1.2.3.6
New organizations & partners 1.2.4
Traditional organizations & partners 1.2.4.1
Non-traditional organizations & partners 1.2.4.2
Emergent organizations 1.2.4.3
Rapidly changing context 1.2.5
Nature / degree of change 1.2.5.1
Speed of change 1.2.5.2
Consequences of change - actual/potential 1.2.5.3
Impacts of interventions 1.2.5.4
Flexibility of interpretive frameworks 1.2.6
Imposed / unilateral process 1.2.6.1
Common / shared process 1.2.6.2
Degree of creativity / improvisation 1.2.6.3

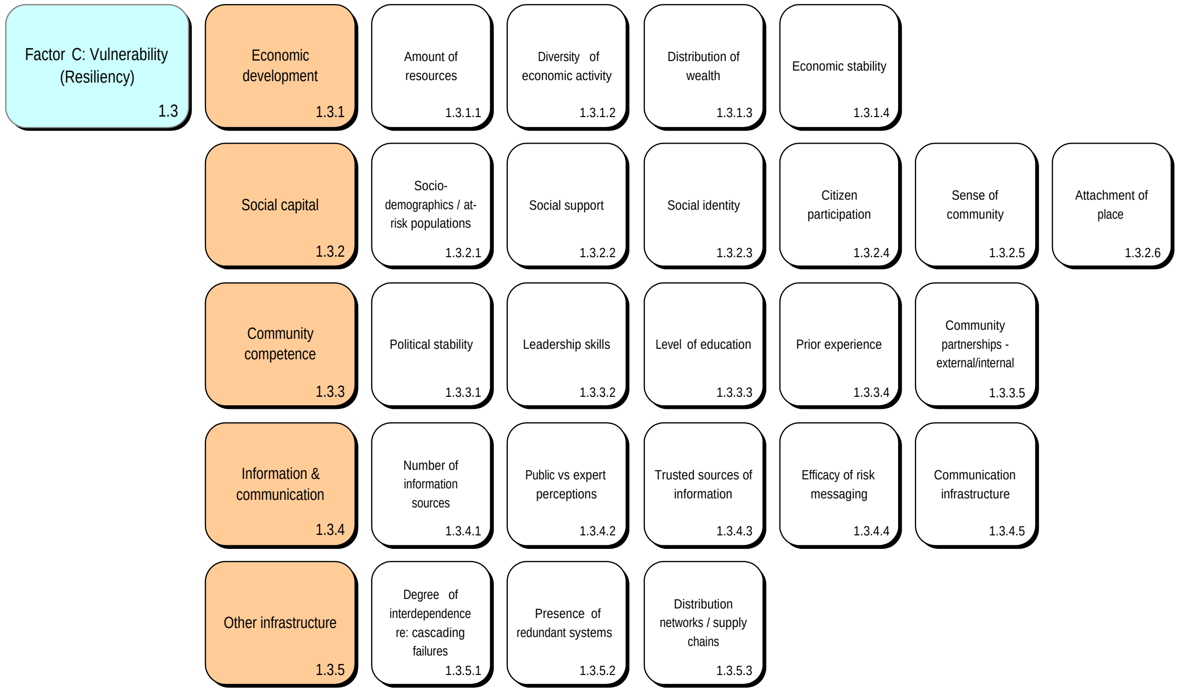


Figure 4: Template scenario elements grid

Experimental Platform

To provide a context or platform for the complex event scenario, the research team will use *Gapville* (see *Figure 5* below), a training tool created as part of the Psychosocial Risk Manager (PRiMer) training program, funded by the Centre for Security Sciences, CRTI-06-0259TD project. Created for use in learning activities and tabletop exercises, this cityscape illustration contains all the built and social infrastructure of a mid-sized North American city. Using *Gapville* as a base, and applying the grid of complexity factors, elements and sub-elements, the research team will design various scenarios that can be assessed to determine which are most appropriate for the study.

If found useful to build comparisons or to initiate convergence of common tools, the initial basic scenario storyboard may be chosen from DRDC current bank of CBRNE and cyber threats or collaborators' sets such as from DHS, FEMA, EU or UK. Then features will be added to match our criteria for complexity and timeframe.

Figure 5: Gapville

4.2.1.2 Assessment of scenario complexity and appropriateness

The research team will initially develop three scenarios and related injects and supporting materials in order to select the most appropriate for use in the study (only one scenario will be used in the study at this point). Currently we are contemplating using scenarios related to a radiation-nuclear attack, a cyber-attack, or a natural disaster. Considerable effort will be expended in developing assessment tools to measure the following:

- Complexity assessments for each of the four periods within each of the three draft scenarios. The assessment tools will be based on the factors, elements and sub elements outlined in *Figure 4 – Template scenario elements grid*;
- Ratings of likelihood of occurrence of scenario;
- Level of appropriateness given subjects experience and knowledge; and
- Consistency of interpretation of key facts by pod members.

Complexity assessments

Once the series of three draft scenarios has been developed, the research team will assess the complexity of each of the four periods for each of the three scenarios. The ratings of complexity will be according to a standard tool developed expressly for this purpose and will be based on the the factors, elements and sub-elements outlined in the grid. An initial draft scaling for each sub-

element has been provided in the *Annex C*. This will be further developed once the series of three draft scenarios have been finalized.

Using the scenario complexity assessment tool, eight raters[4] will be briefed on the elements of situation complexity as per the *Model* outlined in Task 1. Each rater will then consider each situational sub-element within each of the four periods within each of the three scenarios developed to rate the overall scenario with respect to complexity. Judgements from each rater will be examined and used for two purposes. The initial analysis of ratings will be used to select the most appropriate scenario to be used in the experiment. The second use of the ratings will be to improve the sub-elements of the selected scenario. This would be achieved by enhancing or decreasing certain sub-elements of the chosen scenario based on raters' feedback.

Assessment of likelihood of occurrence

Given the *in vivo* aspect of the study, it will be important to select a scenario that has a potential to actually occur. As a result, the research team will also develop a second brief tool to have the raters performing the complexity assessments also provide ratings and assessments of the realistic nature of the scenario, injects and materials. They will be asked to provide quantitative and qualitative ratings of both the extent to which the overall scenario would be likely to occur, and to identify any aspects of the scenario or materials that were unlikely or not realistic.

Assessment of level of appropriateness of scenarios

The raters performing the complexity assessment will also be asked to comment upon and assess the extent to which the level of problem solving and scenario elements would be appropriate for the likely study subjects. The raters will be provided with a brief description of the intended study subjects with respect to levels, backgrounds and experience, and a tool to capture their ratings of appropriateness for various aspects of the scenarios, injects and materials.

Consistency of interpretation of key facts by subjects

It will be important that the selected scenarios, injects and materials are understood and interpreted consistently across subjects. The assessment of interpretation consistency will be undertaken only once the raters have completed their various assessments and one scenario has been selected. This assessment will take place during the pilot-testing of the overall study sessions by having pilot-test subjects review and provide clarity ratings on all injects and materials, and to ask for a sample of interpretations across pilot-test participants. An assessment tool to elicit and capture this information will be developed for the pilot-testing stage.

4.3 Independent Variables

4.3.1 Independent variable: Type of multi-organizational decision-making approach

A primary independent variable for the study will be *multi-organizational decision-making approach*. As hypothesized in the *Model* described in Task 1, problem solving in multi-organizational context should attempt to reduce situation complexity in order to effectively implement solutions. The extent to which a specific type of approach is optimal depends on the

[4] Raters will be a mix of experienced responders, decision-makers or trainers of various backgrounds.

actual level of situation complexity encountered, and can be modified by the assets available to each organization, and the various stages of problem solving. As described in the overview in *Section 2.0*, the goal of the present study is to effectively manipulate both multi-organizational approach and multi-organization context to test the optimal approach to problem solving in complex situations, as measured through decision outcomes and processes.

The multi-organizational approach will be manipulated during the experiment by releasing four types of task instructions to the pods. Four of the eight sessions will be focused on coordinating tasks, while the other four sessions will be focused on collaborating tasks. The tasks will take the form of specific instructions for the pod members to develop a product (e.g., definitions of the main problem, prioritised list of options) using a specific approach within the six problem solving stages (i.e., problem identification, problem definition, solution generation, decision making, solution implementation, and feedback on success/failure).

The main design principles of the tasks include:

- Tasks will consist of instructions for a group task that outline: a) the approach that should be followed (e.g., work independently, consult each pod member, consult other pods, gain complete consensus); and b) the product that needs to be developed (e.g., table outlining most likely impacts of potential actions).
- Tasks will include time limits for the task completion (e.g., 30 minutes).
- Tasks will be concise (less than 1 page) and easily interpretable – limited time during the session should be used by pod members trying to clarify what is required. Most of the time should be used to work on the tasks.
- Tasks will coincide with events happening in the scenario.
- The various tasks will cover three stages of problem solving, i.e., problem definition, solution generation and decision making.
- During a session, identical tasks will be administered to each pod at the same time from the control room via the online conferencing system.
- Tasks will be developed in such a manner as to ensure that the same problem solving stages are occurring in each group (i.e., problem definition, solution generation, decision making), and the same approach to problem solving is being used (i.e., coordination or collaboration).
- The number, timing and stage of problem solving of tasks will be identical across sessions, regardless of session type.

4.3.1.1 Description of task development process

In order to develop tasks that effectively manipulate the inter-organizational approach to problem solving, the tasks will be developed based on a 3-way grid outlining the analysis of the four inter-organizational approaches by levels of shared assets according to the six stages of problem solving (see *Annex D*). By having operationalized the six stages of problem solving into observable behaviours as outlined in the grid, the research team will be able to design task directions that will elicit the specific behaviours associated with either coordinating or collaborating at the problem definition, solution generation and decision making stages. Based on the 3-way grid analysis, the task development process will follow the design principles outlined above. While four different tasks will be required to implement the study, initially, we will

develop twelve tasks (4 X 3) from which the most appropriate four will be chosen, once calibration has occurred.

4.3.1.2 Assessment process for problem solving tasks

The problem solving tasks used in the scenario will undergo a similar assessment process to that used for rating scenario complexity. This will ensure that the tasks will be able to elicit either coordination or collaboration behaviour during each of four periods during the study session. The same raters who will be undertaking the complexity assessment will be initially asked to judge the extent to which each of the tasks are likely to elicit collaborative or coordinating behaviours based on the key definitions and behaviours outlined in the original analytic 3-way grid. An assessment tool designed to elicit and collect these ratings will be developed based on the analytic 3-way grid. Ratings will be used to not only select the most appropriate tasks, but also to improve the set of tasks ultimately selected for the study.

In addition to the ratings provided, the selected tasks will be pilot-tested with small groups of three people to observe the extent to which collaborative and coordinating behaviours are actually elicited by the various tasks. Tasks will be adjusted accordingly to ensure that they are appropriate for eliciting the desired coordination or collaborating behaviours. For this process, observation tools will be developed that operationalize coordinating, cooperating and collaborating behaviours to the extent that they can be monitored, observed, recorded and assessed. These tools will be further refined during the pilot-testing phase to be used for coding and observing all 8 sessions. This will provide an internal validity check to the study to confirm that both coordination and collaboration behaviours were elicited from the tasks during the *in vivo* study.

4.3.2 Independent variable: Multi-organization environment

The second independent variable that will be included in the study is multi-organization environment. As described in Task 1, complex problems usually require multiple organizations to work together. This section describes how different types of organizations will be grouped into pods to simulate multi-organizational environments. Section *4.3.2.1 Intra pod description* describes the variations within pod compositions, while section *4.3.2.2 Inter pod description* presents the variations in interactions between pods within each session. Section *4.3.2.3 Description of session and pod composition* describes the ways that these pods will be organized according to session design.

As previously outlined, during each session, three pods of three individuals each will receive scenario injects and instructions from a single control room. Each pod will be located in a separate room but will have the opportunity to communicate with the other pods at certain stages during the session. The control room will observe behaviours both within the pods and between the pods. See *Figure 6* below for a depiction of a session design set up.

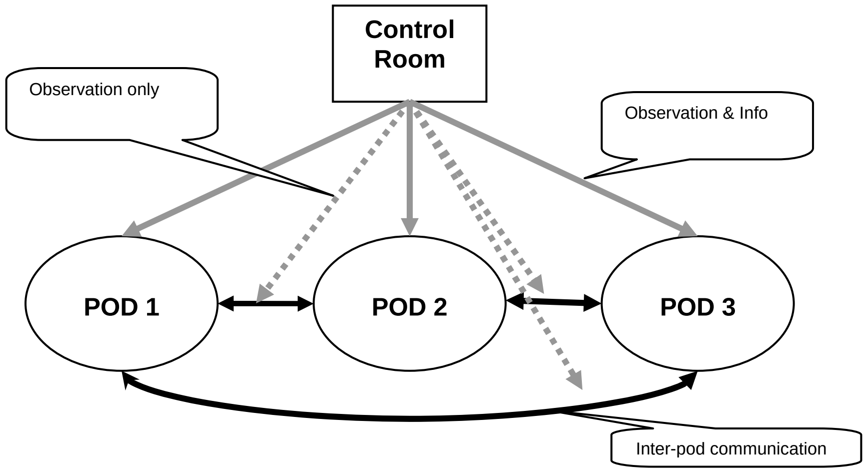


Figure 6: Overall session composition

4.3.2.1 Intra pod description

Pods will be made up of three organization types: Military (M), ICS non-military (I), and Non-ICS (NI). During the experiment, the control room will observe problem solving processes and outcomes within the pods. Following the completion of the experiment, further analysis of the data collected from the pods will illuminate differences and similarities in the ways that people collaborated depending on the composition of the group and depending on whether communication was open or closed. It therefore becomes necessary to discuss the different possibilities for pod composition. There are two possibilities for pod composition within the experimental design, which are outlined below.

Table 3: Pod composition descriptions

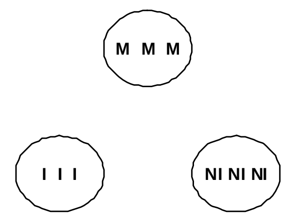
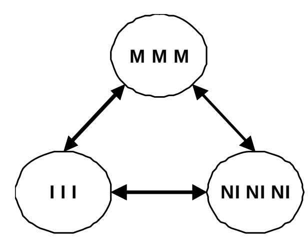
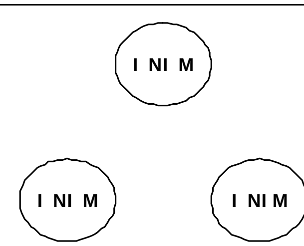
Pod composition	Description	Example
Homogeneous Pod **(Same organization)**	Three members from the same organizational type (Military (M), ICS non-military (I), *or* Non-ICS (NI))	A military pod in which all three participants are from the military; or all from three social service agencies
Mixed Organizations Pod	Three members each from the three different organizational types (Military (M), ICS non-military (I), *and* Non-ICS (NI))	A mixed organization pod made up of a participant from the military, a participant from a police department, and a participant from a non-governmental organization

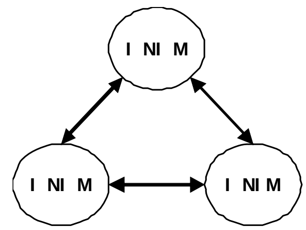
4.3.2.2 Inter pod description

In addition to monitoring and recording communication, information-seeking, decision making and collaborative behaviour within the pods, the experiment will also record these behaviours as they occur between the pods. Later analysis will look at the differences in behaviour according to

the overall composition and interaction during each session. There are four possible configurations for each session of the experiment; these configurations are described below.

Table 4: Configuration descriptions

Configuration	Pod composition	Inter-pod interaction	Description
A	Homogeneous Pod	No communication	 No communication between the three pods, each with all three members from the same type of organizational structure: • Military (M) pod • ICS non-military (I) pod • Non-ICS (NI)) pod
B	Homogeneous Pod	Open communication	 Open communication between the three pods, each with all three members from the same type of organizational structure: • Military (M) pod • ICS non-military (I) pod • Non-ICS (NI) pod
C	Mixed Organizations Pod	No communication	 No communication between the three mixed organizations pods, each with one member from each of the types of organizational structures:

Configuration	Pod composition	Inter-pod interaction	Description
			• 3 X Mixed organizations pod (Military (M), ICS non-military (I), *and* Non-ICS (NI))
D	Mixed Organizations Pod	Open communication	 Open communication between the three mixed organizations pods, each with one member from each of the types of organizational structures: • 3 X Mixed organizations pod (Military (M), ICS non-military (I), *and* Non-ICS (NI))

The changing make-up of the pods is described in Table 5 below. The subscript numbering refers to individual participants and it shows how these individuals are rearranged during the four configurations.

Table 5: Pod members by configuration

	Pod 1			**Pod 2**			**Pod 3**		
Config.	Participant	Participant	Participant	Participant	Participant	Participant	Participant	Participant	Participant
A	M_1	M_2	M_3	I_1	I_2	I_3	NI_1	NI_2	NI_3
B	M_1	M_2	M_3	I_1	I_2	I_3	NI_1	NI_2	NI_3
C	M_1	I_1	NI_1	M_2	I_2	NI_2	M_3	I_3	NI_3
D	M_1	I_1	NI_1	M_2	I_2	NI_2	M_3	I_3	NI_3

4.3.2.3 Description of session and pod configuration

There are two broad approaches for the session design in which all four configurations will be used (A, B, C and D; based on composition and inter-pod interaction). These approaches are defined by coordination and collaboration and include sessions that focus on coordinating tasks as well as sessions that focus on collaborating tasks. The order of the four configurations will rotate. Differences with respect to collaborative or coordinating behaviour will be noted according to the ordering of these configurations. See Table 6 below for the arrangements of configurations according to problem solving approach.

Table 6: *Stage ordering by pod configuration and problem solving approach*

Session No.	Stage 1	Stage 2	Stage 3	Stage 4	Approach
1	A	B	C	D	coordination
2	C	D	A	B	coordination
3	B	A	D	C	coordination
4	D	C	B	A	coordination
5	A	B	C	D	collaboration
6	C	D	A	B	collaboration
7	B	A	D	C	collaboration
8	D	C	B	A	collaboration

The number of participants that are needed for the experiment are described in *Table 7* in terms of the organizational type of the participants' workplace.

Table 7: Number of participants needed according to organizational type

Organizational Type	No. Participants per Session	No. Participants For Experimental Design
Military (M)	3	**24**
ICS non-military (I)	3	**24**
Non-ICS	3	**24**
All	9	**72**

4.4 Dependent variables

As outlined in Section *2.1*, the dependent variables for the study will focus on the problem solving processes and outcomes. Given that the sessions will be video and audio-recorded, this will provide copious amounts of rich process data that can be assessed to determine the extent to which independent variables are having an impact on the problem solving processes. Similarly, the tasks developed will result in problem solving "products" and documentation of decisions. These will constitute the source data for measurement of problem solving outcomes.

Overall, there will be two sets of dependent variables: one set focusing on problem solving *processes*; a second set focusing on problem solving *outcomes*. The main dependent variables outlined for problem solving processes include:

- Satisfaction with problem solving process (individual, collective, external panel);
- Level of participation with each pod;
- Level of participation between pods;
- Time spent on problem solving stages;
- Pattern of engagement in problem solving stages; and
- Task and group cohesion.

The main dependent variables outlined for problem solving outcomes include:

- Decision quality (individual, collective, external panel);
- Satisfaction with problem solving outcome (individual, collective, external panel);
- Level of agreement on outcome; and
- Changes in individual and collective goals.
- Time to reach decision

Various measures will be developed for each of these variables. Measures will take the forms of self reports, participant ratings, observation, and time/content coding. More detailed information and measurement considerations for each of the proposed dependent variables are contained in *Annex E*.

4.5 Analysis plan

Once the dependent variable measures have been finalized, the detailed analysis plan will be developed for the experimental component. Initially, once data have been coded and cleaned, the team will undertake extensive descriptive analyses for each measure to assess basic data characteristics such as outliers, normality, linearity, and homoscedasticity. Once we have determined the basic data characteristics, the primary analyses are anticipated to include analyses of variance and covariance (ANOVA, ANCOVA, MANOVA, MANCOVA). This will result in the testing of the main effects of each of the three independent variables, along with the interactions between variables. Contingent on the results of the analyses of variance and covariance, post-hoc comparison testing will be undertaken to further interpret main effects and/or interactions.

Depending on the final selection of dependent variable measures, there may be some opportunities to further explore the findings from the primary analyses using correlational techniques to understand the relationships among certain dependent variables. This will facilitate a better overall understanding of problem solving processes and outcomes. Consideration will be given to integrating these types of analyses in the detailed analysis plan.

5 Feasibility and Contingency Analysis

5.1 Feasibility of experimental plan

In Section *2.2* Overview of research strategy, some of the theoretical research challenges and limitations of the proposed approaches to the experiment are identified. Acknowledging these conceptual challenges, this section focuses on identifying the more practical issues of implementing a study of the scope and breadth proposed herein. The more significant practical issues centre on:

- Recruitment of the requisite number of study participants
- Identification and selection of the most appropriate types of participants (organizational level, experience, etc)
- Participant availability (location /time) for study session and handling "no shows" due to urgent matters to be attended to
- Technology requirements for the conduct of the study
- Ethics approvals

Failure to take into account these issues over the timeline of the experiment has the potential to negatively impact the study outcomes. The study design as proposed though, is feasible. Although there may be specific elements of the design that appear daunting to implement (e.g., number of recruits needed), we view this as more of a "complicated" problem rather than a "wicked" problem. The experimental design employs an approach similar to the proven Hydra system and technologies for data transmission and capture are now very robust and user friendly. Anticipatory planning and attention to detail during the implementation cycle will mitigate many of the risks associated with the issues noted above.

5.2 Risks and contingencies

This section sets out the risks and specific mitigation strategies for each of the issues identified above. Note that these risks pertain specifically to Component 2: Experiment, with the exception of *Risk 6: Delays in obtaining ethics approvals*, which applies equally to Component 1: Qualitative Interviews and Component 2 Experimental design.

Risk 1: Unable to recruit requisite number of study participants

The study design indicates the need for a total of 72 participants for Component 2: Experiment. These are needed in increments of nine for 8 sessions over the implementation timeline. The large number of participants requires an aggressive recruitment drive of potential candidates. While recruitment of participants for the simulations is according to contract the responsibility of the Technical Authority (TA), it cannot be relied on exclusively to meet the needs if the experiment is to be a success. The strategy will be to share responsibility for recruitment between the TA and the University of Ottawa, with the project team focusing more on recruitment efforts outside of the military and RCMP. There will be a need to start the recruitment process early and to take into account a 30% drop-out rate (refer to Risk 3).

Risk 2: Unable to select most appropriate types of participants

In addition to recruitment of a large number of study participants, the participants must meet a number of selection criteria. These criteria have been specified in Section *4.1.2 Description of subjects/sample*. The criteria have been developed to include as broad a spectrum of potential participants as possible and still make pod compositions realistic and credible for the type of scenario presented. The relatively senior level of participants will make their recruitment difficult, given the time demands of their jobs. With some creative scheduling and limiting the length of the simulation to half a day in total, this risk will be somewhat mitigated.

Risk 3: Scheduling conflicts affect participant availability for a planned session

Experience indicates that scheduling conflicts will occur and participants will decline attendance at the last moment due to urgent matters/sickness, putting the running of a session in jeopardy. To mitigate this risk, for each session, three to four additional participants will be recruited and placed on "call". These individuals will be utilized on an as needed basis. Two make-up sessions will also be planned towards the end of the implementation phase. Individuals on "call" who have not participated up to this point will have an opportunity to do so. In addition to the above, the timing of the initial 8 sessions will take into account the periods when participants are most likely to be available.

Risk 4: Hardware/software utilized fails to perform as per specifications

As with the utilization of any computer hardware and/or software, there is a risk that it will not work when you need it and the simulation process will be disrupted. These risks will be mitigated by choosing proven equipment and software, training technical staff in advance on the equipment/process and providing technical staff at each physical location to troubleshoot problems, if indeed they should arise. A technical run though will be made before commencement of each session to verify that the equipment and systems are operational.

Risk 5: Delays in obtaining ethics approvals negatively affect project schedule

Obtaining ethics approval for a research design of this type is an onerous task. It places a significant administrative burden on project resources. Delays in obtaining approvals may occur either in the preparation of the myriad documents or in the actual review process. Any significant delay will impact on the windows of opportunity to hold study sessions. Fortunately, the project team is familiar with the ethics submission and approval process and the Ethics Review Board is sensitive to the time demands of major research initiatives. The chief mitigating strategy is to prepare and submit early a well documented study design that addresses all the ethics requirements and avoid requests for additional clarifying information. If clarifications are needed, the focus will be on a quick turn-around of the necessary forms.

6 Implementation: Next Steps

6.1 Component 1 – Qualitative interviews

6.1.1 Prepare interview guide

As an initial step, the instructions that guide the administration and implementation of the qualitative interviews will be set out in an interview guide. The guide will ensure consistency across interviews, and thus increase the reliability of findings. The guide will include what to say to the interviewee before, during and after the interview and what to do during and following the interview. Questions included in the guide will focus on the concepts of complexity of the situation, multi-organizational problem solving, and the multi-organizational environment. The exact wording of the questions may vary slightly depending on the case study under examination. Given the length of the interview (i.e., 1 hour), approximately 10 main questions will be used along with additional probes (see *Annex B*). The guide will include a standard informed consent form.

6.1.2 Prepare ethics submission and obtain approval

The qualitative interview component of the study will require ethics approval as per the University of Ottawa guidelines and the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS). Upon acceptance of Task 2 by the Technical Authority, separate ethics submissions will be undertaken for Component 1 and Component 2 are as of research. This will ensure a faster turn-around time for approval related to Component 1.

6.1.3 Identify/select interviewees

The case studies documented in Task 1 will serve as a starting point for identifying and selecting interviewees. Three to four case studies will be utilized to compile a listing of potential interviewees. Identification and selection of potential interviewees will be done with the assistance of DRDC. The aim will be to maximize the number of interviews at one location for increased efficiency.

6.1.4 Test interview process/instruments, train interviewers

Both interview process and instruments will be pilot tested. The questions posed in the guide will be vetted by a small expert panel for relevancy and consistency with the stated research questions. Two interviewers will be given a thorough review of the SDM framework and the rationale for question choices. They will have several opportunities to practice the interview process, particularly the use of probing questions. Based on the pilot tests, adjustments will be made to the interview questions and/or process as appropriate.

6.1.5 Conduct interviews

The project schedule indicates that the qualitative interviews will start late summer 2010, and continue over the Fall period. Interviewee availability will determine the exact start and end dates of this step. Completion of interviews by late Fall, 2010 provides adequate time for collation and

analysis of the data and the preparation of an interim summary on findings by mid-January, 2011. This will permit incorporating the findings into the interpretation of the *in vivo* simulation results.

6.2 Component 2 – In Vivo Simulation Experiment

6.2.1 Development and calibration of scenarios

A number of scenarios (3) will be developed utilizing the grid of complexity factors, elements and sub-elements. Next steps will be to finalize these scenarios and assess which is most appropriate for the study. Several experts will be asked to review each of the scenarios for face validity. After adjustments are made, raters will be recruited from within the University of Ottawa to rate each of the scenarios in terms of their level of complexity. Each potential rater will attend a briefing on the SDM framework and the definitions of situational complexity. To ensure the potential raters are suitable, a multiple choice test will be administered after the briefing, to determine if they retained the necessary information to prove a reliable rater. Once accepted, the raters will be presented with the master scenario of events, and the set of scales designed to rate each element's situation complexity. Raters will be asked to fill out all the scales. The goal is to achieve inter-rater reliability among raters as to what constitutes a "complicated" situation versus a "complex" situation. Based on rater feedback, the most appropriate scenario will be chosen for the study and modifications made, if required, before launching the experiment.

6.2.2 Development and calibration of problem solving

As indicated earlier, the problem solving tasks used in the scenario will be submitted to a similar calibration process to that used for rating scenario complexity. Once the most appropriate scenario has been selected, eight potential tasks will be reviewed by a number of independent raters (5) to judge the extent that each will elicit collaborative or coordinating behaviours based on the key definitions and behaviours described in the analytic 3-way grid. An instrument will be prepared to document the rater judgements. As a check on these judgements, the tasks will also be pre-tested in several small group settings. The four tasks that consistently receive the highest ratings from both approaches to calibration will be included in the study.

6.2.3 Finalization of measures for problem solving process and outcomes

As indicated in *Annex E*, a number of measures will need to be developed in house. Additionally, measures will be adapted from existing measures on task and group cohesion. Corresponding forms will need to be developed for both the measures developed in-house and the adapted measures. The self report measures and forms will be tested in order to ensure that the questions are clear. Processes will be created for time coding video and audio recordings and a codebook will be produced for content coding.

6.2.4 Develop detailed study protocols

The effective conduct of both components of the study will require development of detailed research protocols. The specific requirements for calibration of the scenario and tasks and for finalizing the measures for problem solving processes and outcomes have already been identified. In addition, specific protocols will need to be developed for

- recruiting and registering study participants;

- obtaining informed consent;
- introducing the experiment to participants (briefing materials);
- sequencing activities / tasks within the simulation;
- using the data collection instruments both qualitative and quantitative to track problem solving processes, outcomes and participant observations;
- facilitating the de-briefing process;
- maintaining participant confidentiality; and,
- ensuring secure storage and retention of completed study materials.

6.2.5 Prepare submission and obtain ethics approval

Ethics approval is required before implementing the proposed research design for *in vivo* simulation of meta-organizational shared decision making. Research protocols demand that "the University of Ottawa and its investigators and students whose research projects involve the participation of human beings as research subjects must comply with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS), the University of Ottawa's guidelines, and other relevant guidelines and legislation. This is both a collective and individual responsibility" (Research Ethics Board Project Submission Form, 2005, page 13). Thus, a key next step will be to undertake a formalized ethics approval process and prepare a detailed submission to the University's Research Ethics Board for approval. The ethics approval process will also address the issue of participant safety. While it is unlikely that participants will have had direct experience with the exact scenarios that will be developed, there is a remote possibility that the scenario may trigger a high stress reaction. The very nature of the scenario, along with the injects, visuals, and video will be designed in such a way as to reduce stress by avoiding the use of imagery or subject matter with a high dread factor. The submission documents will need to summarize the research protocols, methodologies, specifics on recruitment and selection of participants, risks and benefits of proposed research (including measures to minimize or mitigate risks), the informed consent process, and how anonymity and confidentiality will be ensured.

6.2.6 Obtain, set-up and test equipment and facilities

The study environment requires the use of computer hardware/monitors and online conferencing software by controllers of the experiment and by participants. Brand name laptops (e.g., Dell, IBM) will be used within the pods and control room as described in section *4.1.3 Description of study environment and processes.* All laptops will be pre-loaded with the necessary software and additional data collection forms. The turn-around time to purchase the computer hardware is relatively short (i.e., a month). Research has already begun on identifying possible online conferencing software (e.g., Nefsis, Net Meeting, Goto Meeting). This software will be leased on a monthly basis over the duration of the experiment and affords the benefit of an easy install, no maintenance and quick access at any location (provided high speed internet access is available at the location). The testing of equipment can be done well in advance of running a session. Video cameras will also be purchased for each pod. The video cameras will be a redundant system to help mitigate against any data loss or data quality problems occurring with the conferencing system. These cameras can be mounted to the ceiling with magic arms and taken down quite easily and require little training on how to operate. These cameras will record to a local tape and be collected at the end of the session for analysis. A short video will be made on how to use the online conferencing software and viewed by participants just prior to the conduct of each session

of the experiment. A trained technician will be on hand at each location to answer questions. The control room for all the sessions as well as three additional rooms for the pods will be housed at the University of Ottawa.

6.2.7 Training technical staff, facilitators and observers

Staff within the project team is familiar with the proposed hardware and software set-up and operational requirements. A technician will be available for on-site set-up. Three observers located in the control room, one for each pod monitor, will be trained in filling out an observation log related to conversations/actions performed by members of their assigned pod. The observation logs will help in cueing the recorded information to items of interest. A briefing and debriefing guide will be prepared for use by the session facilitator. This guide will include sections on how to introduce the experiment to participants, the sequencing of simulation activities/injects and offer directions on the debriefing process and content. Two facilitators will be trained in the use of these materials. Initial training will consist of several informal walkthroughs of the experiment.

6.2.8 Pilot testing of study environment and processes

Pilot testing will be undertaken related to each independent variable. The facilitation of the simulation and observation of participants will all take place from within the control room. Students will be recruited to act as participants in the various pods for each pilot test. For consistency and time control, the introduction to the experiment and elements of the debriefing process will be presented on video.

6.2.9 Recruit subjects

Challenges related to recruitment of study subjects have been alluded to in earlier sections on descriptions of subjects, pod composition and feasibility of experimental plan. Immediate next steps will be to draw up a master list of potential participants for the experiment using existing networks of contacts. Potential participants will be identified by both DRDC and the University of Ottawa. The compilation of the initial list will be undertaken using the subject profile described in Section *4.1.2* and session and pod composition grids described in Section *4.3.2.3* as identification and selection guides. The recruitment pool will be refreshed on a continuous basis over the conduct of the experiment. Participant involvement in the study will be voluntary and their consent will be obtained as per ethics requirements.

6.2.10 Launch experiment

The project schedule indicates that the experiment will be run from mid-September, 2010 through to late January, 2011. Eight sessions will be conducted during this time period, with the specific dates yet to be finalized in order to accommodate limited participant availability. Several make-up sessions will also be planned in late January, 2011. These are not yet shown on the schedule. Completion of the 8 sessions by late January, 2011 provides adequate time for collation and analysis of data and the preparation of the report on findings by March 31, 2011.

6.3 Project schedule

The project schedule lists the start and end dates for each of the six work packages associated with completing the entire project. Refer to *Annex F* for details. The milestones and deliverables for work packages 1 and 2 have been completed. For the next work package, i.e., W3 Testing of SDM framework in vivo using simulation, specific tasks are identified. These tasks are grouped under two main components, qualitative interviews and experiments. The details about these tasks are described in the sections above. As with earlier work packages, a draft report of the findings will be submitted for review one month prior to final submission. Work package 3 is scheduled to start on June 30, 2010 and finish on March 31, 2011.

7 Application of findings and future considerations

This section outlines potential steps in applying the findings from this study to the CF context and, depending on the outcome of the study, potential avenues of further investigation that would contribute to achieving the overall TIF objectives. While the tasks outlined in this section are not within the current timeframe and resources allocated to the present project, it is beneficial to consider throughout the project (including this early planning stage) how the findings or knowledge derived from this study can be translated, applied, and transferred to real-world settings and situations.

7.1 Measuring situational complexity

This study will result in refined tools to assess situation complexity. These tools will be grounded within an extensive theoretical framework and sound methodological approach. It will be designed to measure multiple aspects of any situation to determine the extent to which the event at a particular time is simple, complicated or complex. These tools could be easily adapted to other contexts such as training scenario development, assessment of past situations for more standardized categorization and analysis, or planning for future extreme events. Depending on the ease with which they can be implemented (i.e., checklist format), they may even have potential to contribute to situational awareness in ongoing events.

7.2 Measuring collaboration, cooperation and coordination

In addition to tools measuring situation complexity, this study will result in tools designed to assess the extent to which collaboration, cooperation and/or coordination is occurring within a multi-organizational context. Considerable effort will be expended during the current study to develop tools that operationalize these concepts. These tools will be used by both external raters and participants to assess the approach to problem solving employed and to ensure that collaboration is taking place during the experimental sessions. These tools may have utility outside of the experiment in areas such as evaluation of training interventions, or assessment of problem solving post-situation for key events, and identification of critical factors.

7.3 Further investigate impact of situation complexity on problem solving outcomes

Given the resources and timeframe for the current study, situation complexity has been restricted to a control variable with the focus being placed exclusively on complex events. The *Model* outlined in Task 1 predicts that optimal problem solving will vary according to the complexity of the event and stage in the response and event timeline. This aspect of the model could be tested at a later date relatively easily once the study infrastructure has been developed (e.g., scenario injects, task instructions, pod communication).

7.4 Further investigate stages of problem solving and non-linear problem solving processes

Similar to situation complexity, the current study is restricting the experiment to focus on three problem solving stages from what has been characterized in the model as a relatively linear problem solving process (e.g., problem definition, solution generation, decision-making, etc.). There are indications in the literature that effective problem-solving is often not as linear as depicted, and more likely iterative, back-and-forth, with stages skipped along the way (Paquet, 2009; Edwards, Miles & vonWinterfeldt, 2007). The non-linearity aspect of problem solving may potentially increase as the process becomes more collaborative. While the model provides an interpretable approach to problem solving, the overall model would benefit from further work that could characterize the iterative, non-linear nature of the problem solving process in complex events. It is anticipated that some initial data may be collected on this aspect through the in-depth, qualitative interviews with decision-makers in Component One of the current study.

7.5 Further investigate impact of various scenarios

To hold situation complexity as a control variable, the study will use one scenario that has been assessed by raters as most appropriate according to a number of criteria as outlined in Section *4.3.1.2 Assessment process for problem solving tasks*. A similar study could be run with various scenarios while holding other variables constant (e.g., multi-organizational context, problem solving approach). The addition of multiple scenarios with varying levels of complexity (see point #3 above) could contribute to the better understanding of how the actual content of a scenario can impact on the problem solving outcomes. Scenarios could vary according to aspects such as naturally occurring disasters vs. malicious intent, international vs. domestic, infrastructures impacted, etc.

7.6 Extend the timeline to include collaboration in pre-event planning stages

The scenario for the current study will focus on a limited portion of the event timeline (likely -1 to +1). This is perhaps not that far from reality as to when multiple organizations are actually brought together to address an extreme event. Ideally the process of problem solving would occur earlier in the event timeline during the pre-event planning stages (-2 and -3). A study focusing on the planning, pre-event stages would provide additional information and data for developing training exercises and materials for how to effectively collaborate, cooperate and coordinate at the pre-event stages within a multi-organizational context, which in turn would likely improve the problem solving at the -1 to +1 stages. This use of our design could obviously serve as well for training or intervention to foster a collaborative approach to problem-solving.

7.7 Exploration of the roles of leadership vs. stewardship in process of problem solving in the multi-organizational context

While not within the scope of the current experiment, a common question that persists when attempting to have different organizational structures work together in a coordinated, cooperative and collaborative manner is: *who is in charge*? While this question may be a non sequitur for those organizations which rely on a more collaborative, non-hierarchical structure, it is an essential question for most organizations, particularly those who operate using an ICS approach

to addressing situations. Given the challenges in addressing this question in a collaborative endeavour, it can create frustration and unease among and within organizations who are asked to think about leadership and "who is in charge" in a different manner when participating in a collective effort. Recent work on collaboration, governance, and decision-making where traditional notions of "leadership" are reconceptualised as "stewardship" could be useful in developing approaches that are more congruent with collaboration, and yet, acceptable to those coming from more traditional leadership models (Paquet, 2009).

7.8 Translation of tasks into training materials for learning and practicing collaborative techniques in multi-organizational settings involving complex situations

One key independent variable is approach to problem solving. Considerable effort will be expended in developing specific tasks that will result in either coordination or collaboration within and between various pod compositions. These tasks could be translated into training materials for learning and practicing techniques in coordination, cooperation and collaboration.

7.9 Transfer experimental setting into prototype training setting

Given the *in vivo* nature of the experimental setting, it could be transformed from an experimental setting into a prototype training setting which would apply the various findings from the study into a training context using many of the same materials, along with potentially additional considerations such as additional scenarios, extended timelines and revised tasks (see sections *7.5*, *7.6*, and *7.8* above).

7.10 Test prototype training with recruits/trainees and develop materials and recommendations for training of members of operational community

Once prototype training modules had been developed, they could go through a rigorous training evaluation procedure using various groups of CF recruits/trainees, along with participants from various federal, provincial and community agencies. Prototype training materials and tools would be revised accordingly, and recommendations developed for implementation within the operational community.

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Annex A Task 1 Report Figures

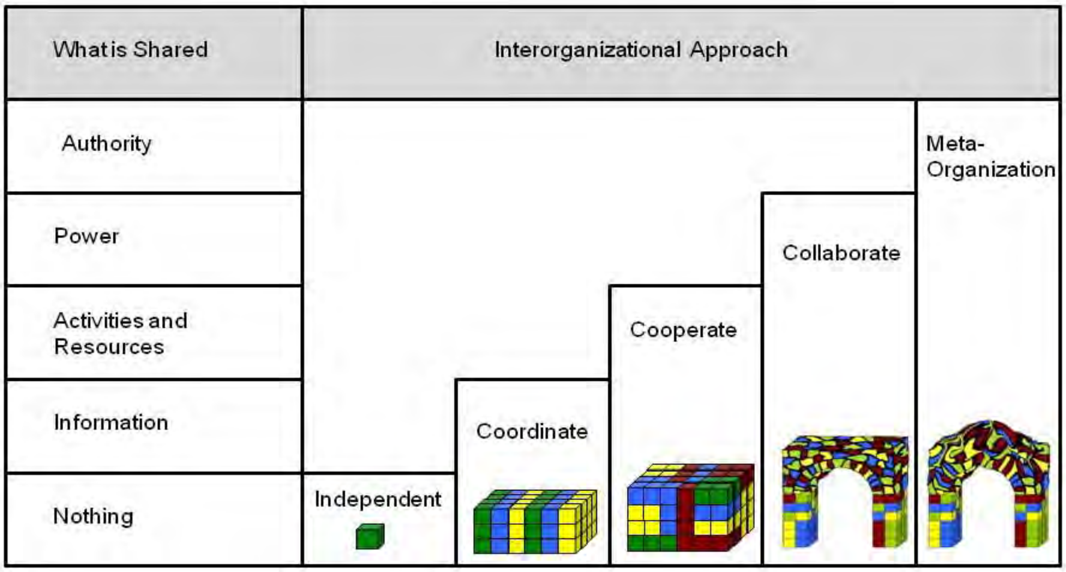

Figure 7: Modifying variables of power, resources and information (adapted from Crosby & Bronson, 2005)

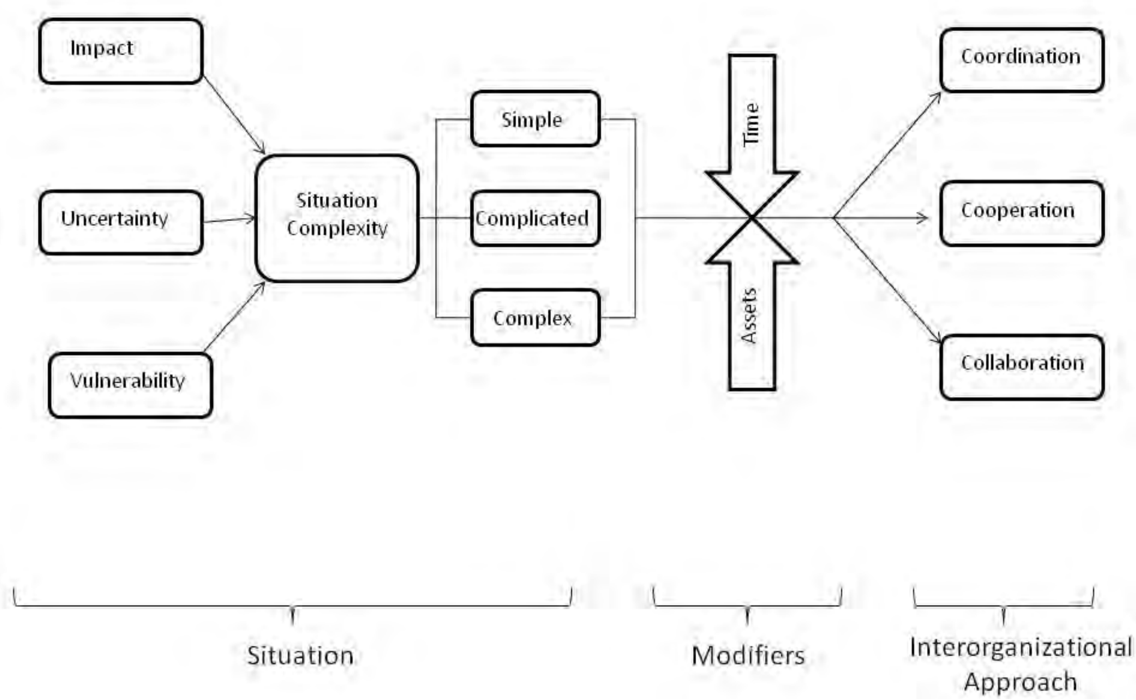

Figure 8: Model of inter-organizational problem solving

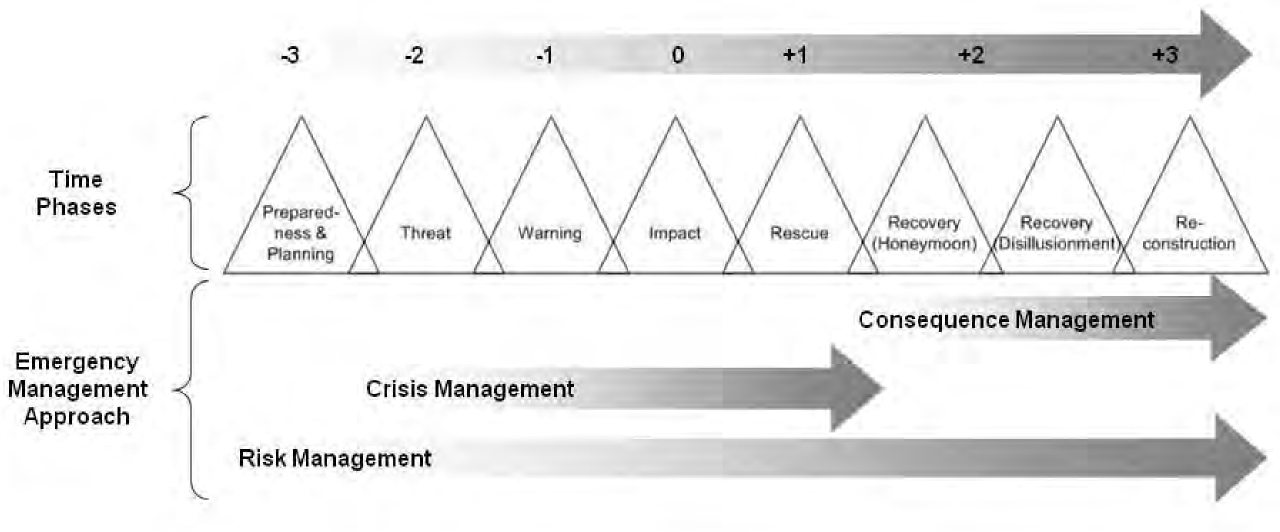

Figure 9: Management approaches by time phase

Figure 10: Representation of interdependence of coordination, cooperation, and collaboration

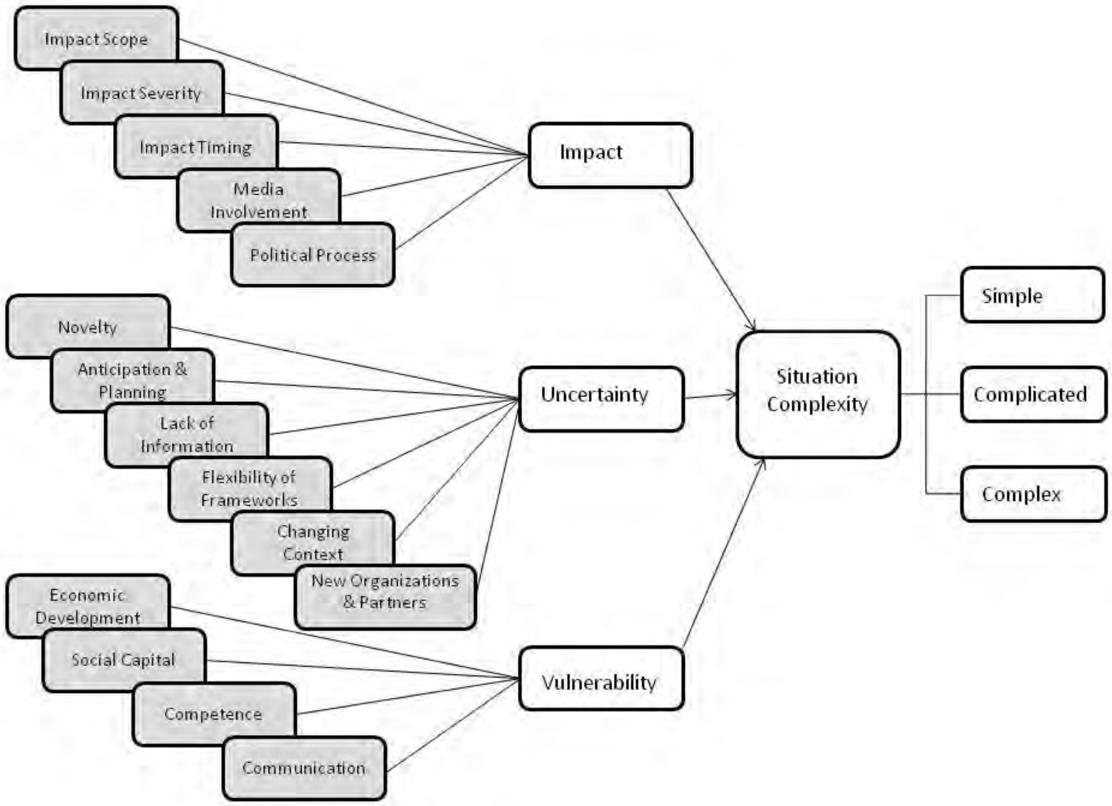

Figure 11: Three factors contributing to situation complexity

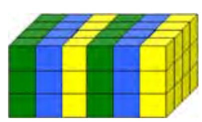

Figure 12: Representation of coordinated organizations

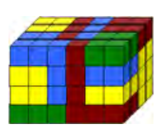

Figure 13: Representation of cooperating organizations

Figure 14: Representation of collaborating organizations

Annex B Preliminary Guidelines for Interviews

Background

This part of the research project will explore the narrative of key decision makers of major events. Specifically we wish to explore how they managed complex crisis that involved the participation of multiple organizations. The research project, led by Dr. Louise Lemyre from the Institute for Population Health at the University of Ottawa, is funded by the Defence Research and Development Canada (DRDC). This phase of the project will involve 20 to 30 individual interviews across the region of Ottawa, Montreal and Toronto, the location of the interviews will be agreed according upon the interviewee`s convenience to assure a confidential environment since the nature of the responses might imply delicate organizational topics. The interviews will be conducted by a senior interviewer and a note taker, and be tape recorded so that they can be transcribed. The responses will be further analyzed by the research team in keeping the confidentiality agreement.

The objectives of the interviews are to explore the key stakeholders' perception of multi organization problem solving during complex crisis. The analysis of the results will help to identify the multiple dimensions intertwined in the response of such events, such as complexity, managerial processes, outcomes and multi organizational structures and environment. Given the phenomenological approach of the interviews, the objective is to understand the crisis events from the perspective of the interviewee, therefore no right or wrong answers are to be expected. The interview will be guided following an adaptation from the *"Critical Decision Method"*

The treatment of the data gathered from the interview will be as follows:

- All the audio recordings will be safely stored in the facilities of the GAP-Santé Laboratory
- The information from the interviews will be transcribed verbatim
- The transcribed information will be analyzed using the NVivo software that process qualitative information.

The coding of data will be performed in a cascading manner by two different researchers, then the coding results will be compared. If a consensus is not reached, the coding scheme will be refined or tuned up. Inter-rater reliability will be assessed.

Interview Questions

Probes will not necessarily be asked in the following order and if the question has already been answered the probe will not be used. Questions will be context specific on interviewees' recollection of the event.

Introductory Questions

- What organization do you work for now and what organization did you work for during the situation?
- What is your role currently?
- What was your role during the situation?
- How long had you been in this role prior to the crisis?

1. Will you give me a quick run through the main problems during the incident, where multiple organizations were involved?
    a. Could you describe each of these situations?
    b. What circumstances lead up to each of these situations?
    c. What information did you need in each of these situations?
    d. Who was involved in solving each of these situations?
    e. Which problems were solved?
    f. Were there any special facilitators involved?
        i. How did these special facilitators come about?
    g. Did you feel that anyone was missing from the problem solving process?

Organizational Problem Solving

2. How were the most important issues solved during the event?
    a. Why were the issues solved this way?
    b. What type of power dynamics existed when trying to find a solution to the incident?
        i. before the event
        ii. during the event
        iii. after the event

c. Did someone or some organization take control when making decisions or was there more equality in the decision making process?

    i. What observations lead you to this conclusion?

d. What was the final decision?

Team and task

3. Did you originally expect the problem solving process to occur as it did? Why or why not?

    a. Did any part of the problem solving process surprise you?

    b. Do you usually prefer a different problem solving method than the one you engaged in?

    c. Did you understand the situations in a similar way to those you were working with?

    d. Did you expect other people to participate at the pace that they did?

    e. Did you feel that the individuals you were working with thought like you?

    f. Did you feel that the individuals you were working with understood you?

Problem Solving Process

4. Can you describe the specific problem solving steps that was taken in each situation?

    a. How was the problem identified?

    b. How was the problem defined?

    c. How was the solution generated?

    d. How was a decision reached?

    e. How was the solution implemented?

    f. Did you receive feedback on the success or failure of your implemented decisions?

    g. Were you able to use this feedback in future problem solving?

Sharing

5. Did you perceive sharing between those involved in the incident? And If so, why was there sharing and when did it occur?

    a. Did you perceive information sharing between those involved in the incident?

        i. Did you perceive individuals volunteering information willingly or needing to be asked to do so?

b. Did you perceive activity sharing between those involved in the incident?

   i. Did you perceive individuals volunteering to share activities or did they need to be asked to do so?

c. Did you perceive resources (human resources, economic, or infrastructure) sharing between those involved in the incident?

   i. Did you perceive individuals volunteering resources willingly or did they need to be asked to do so?

d. Did you perceive power sharing between those involved in the incident?

   i. Did you perceive individuals volunteering power willingly or did they need to be forced to do so?

   ii. Did you perceive any power struggles? Please describe it to me.

Goals

6. How were goals discussed, created, and prioritized concerning the situation?

   a. Did you or did anyone you were working with follow personal goals?

   b. Did you or did anyone you were working with follow their organization's goals?

   c. Did you and those you were working with combine your individual organization's goals into a larger goal?

   d. Did you and those you were working with create a new common goal?

   e. Did the goals change as the situation evolved?

Multi-organizational environment

7. From your perspective, what was the effect of multiple organizations participating in joint problem solving?

   a. How did you perceive the level of group cohesion?

      i. How did you perceive the level of group cohesion between individuals from the same organization? And between individuals from different organizations?

   b. What was your perception of the level of conflict between individuals from the same organization? And between individuals from different organizations?

   c. How was conflict managed between individuals from the same organizations? And between individuals from different organizations

   d. What was your perception of the level of agreement between individuals from the same organizations? And between individuals from different organizations?

Complexity

Uncertainty

8. How did you experience uncertainty surrounding these situations?

    a. Did you ever deal with similar situations prior to this event?

    b. Did you anticipate or plan for this problem beforehand?

    c. Did you feel that the information available was sufficient to make a decision?

    d. Were there new organizations or partners involved that you had never dealt with before? And if so, which organizations or partners?

    e. From your perspective was the problem easy to understand?

    f. In your perspective, did the context surrounding the situations constantly change?

        ii. What changed, when did it change, and how did this make an impact?

Workload

9. Could you discuss how the workload changed across situations during the incident? And why did these changes occur.

    a. What needed to be done to solve the main situations?

    b. At some point, did you feel overwhelmed with all the things you needed to do?

Personal Perception

10. What was your level of participation in each situation?

    a. Were you satisfied with the problem solving process?

    b. Do you think the timing of the problem solving process was appropriate?

    c. Were you satisfied with the level of information, activity, resource and power sharing during the problem solving process?

    d. How do you perceive the quality of the decision?

    e. What (other) difficulties did you have?

    f. Is there anything else you would like to discuss?

Annex C Situation complexity rating scales

						SCALE				
						Less complex			More complex	
1.1	**Factor A: Event impact**					0	1	2	3	4
		1.1.1	**Scope of impacts**							
				1.1.1.1	Tier 1: Direct effects	None	Minimal	Moderate	Severe	Catastrophic
				1.1.1.2	Tier 2: Effects on essential services	None	Minimal	Moderate	Severe	Catastrophic
				1.1.1.3	Tier 3: Effects on societal functions	None	Minimal	Moderate	Severe	Catastrophic
		1.1.2	**Severity of impacts**							
				1.1.2.1	Number of fatalities/ casualties	None	Minimal	Moderate	Severe	Catastrophic
				1.1.2.2	Amount of physical damage	None	Minimal	Moderate	Severe	Catastrophic
				1.1.2.3	Amount of psychological trauma	None	Minimal	Moderate	Severe	Catastrophic
				1.1.2.4	Degree of dispersion - people / place	None	Community	Regional	National	International
				1.1.2.5	Degree of impact on response organizations	None	Minimal	Moderate	Severe	Catastrophic
		1.1.3	**Timing of impacts**							
				1.1.3.1	Threat / warning only	Yes				No
				1.1.3.2	Sudden / short	No				Yes
				1.1.3.3	Sustained / lengthy	No				Yes
				1.1.3.4	Recurring / intermittent	No				Yes
		1.1.4	**Involvement of media**							
				1.1.4.1	Degree / length of coverage	None	Minimal	Moderate	Extensive	Excessive
				1.1.4.2	Impact on perceptions	None	Minimal	Moderate	High	Very high
				1.1.4.3	Access to official sources of information	Very large number of sources / easy to access	Many sources / Somewhat easy to access	Moderate number of sources / access neither difficult nor easy	Few sources / Somewhat difficult to access	No sources / no access

						SCALE				
						Less complex			**More complex**	
						0	1	2	3	4
				1.1.4.4	Utilization of social media	Very effective utilization	Effective utilization	Somewhat effective utilization	Ineffective utilization	No utilization
				1.1.4.5	Degree of public outrage / fear	None	Minimal	Moderate	High	Very high
		1.1.5	**Political processes**							
				1.1.5.1	Number of jurisdictions	None	Low	Moderate	High	Very High
				1.1.5.2	Type of jurisdictions	Local only	Local and regional	Local, regional and national	Local, regional, national and military	Local, regional, national, military. international
				1.1.5.3	Level of jurisdictions	Commun-ity	Regional	National	Military	International
1.2	**Factor B: Uncertainty**									
		1.2.1	**Novelty of situation**							
				1.2.1.1	Hazard type - CBRNE, other	Not CBRNe				CBRNe
				1.2.1.2	Cause: unknown, malicious, accidental	Known cause, accidental	Known cause, malicious	Unknown cause, accidental	Unknown cause, unknown if accidental or malicious	Unknown cause, malicious
				1.2.1.3	Degree of prior experience	Very high	High	Moderate	Low	None
				1.2.1.4	Controllability	Very high	High	Moderate	Low	None
				1.2.1.5	Latency	No				Yes
		1.2.2	**Anticipation & planning**							
				1.2.2.1	Developed plans - known/ unknown hazards	No				Yes
				1.2.2.2	Rehearsed plans	Plans very well rehearsed	Plans well rehearsed	Plans somewhat rehearsed	Very little rehearsal of plans	No rehearsal of plans
				1.2.2.3	Shared plans	Extensive sharing of plans	Plans shared	Some sharing of plans	Very little sharing of plans	No sharing of plans
		1.2.3	**Lack of data & information**							
				1.2.3.1	Access to information	Easy to access	Somewhat easy to access	Access neither difficult nor easy	Somewhat difficult to access	No access
				1.2.3.2	Accuracy/ completeness of information	Very accurate and complete	Accurate and complete	Partially accurate and partially complete	Inaccurate and incomplete	Very inaccurate and incomplete

						SCALE				
						Less complex			More complex	
						0	1	2	3	4
				1.2.3.3	Comprehensibility of information	Very easy to understand	Easy to understand	Somewhat easy to understand	Difficult to understand	Very difficult to understand
				1.2.3.4	Credibility of information sources	Highly credible	Somewhat credible	Credibility not known	Credibility suspect	No credibility
				1.2.3.5	Volume of relevant /extraneous data	None	Low	Moderate	High	Very high
				1.2.3.6	Speed of information flow	Very fast	Fast	Moderate	Slow	Very slow
		1.2.4	**New organizations & partners**							
				1.2.4.1	Traditional organizations & partners	Yes				No
				1.2.4.2	Non-traditional organizations & partners	Yes				No
				1.2.4.3	Emergent organizations	No				Yes
		1.2.5	**Rapidly changing context**							
				1.2.5.1	Nature / degree of change	Very positive	Positive	Neutral	Negative	Very negative
				1.2.5.2	Speed of change	Very slow	Slow	Moderate	Fast	Very fast
				1.2.5.3	Consequences of change - actual/potential	Very positive	Positive	Neutral	Negative	Very negative
				1.2.5.4	Impacts of interventions	None	Low	Moderate	High	Very high
		1.2.6	**Flexibility of interpretive frameworks**							
				1.2.6.1	Imposed / unilateral process	No				Yes
				1.2.6.2	Common / shared process	Yes				No
				1.2.6.3	Degree of creativity / improvisation	None	Low	Moderate	High	Very high
1.3	**Factor C: Vulnerability (Resiliency)**									
		1.3.1	**Economic development**							
				1.3.1.1	Amount of resources	Very high	High	Moderate	Low	None
				1.3.1.2	Diversity of economic activity	Very high	High	Moderate	Low	None
				1.3.1.3	Distribution of wealth	Very low level of inequity	Low level of inequity	Moderate level of inequity	High level of inequity	Very high level of inequity

						SCALE				
						Less complex			More complex	
						0	1	2	3	4
				1.3.1.4	Economic stability	Very strong	Strong	Moderate	Weak	None
		1.3.2	**Social capital**							
				1.3.2.1	Socio-demographics / at-risk populations	None at-risk	Few at-risk	Moderate number at-risk	Many at-risk	Very many at-risk
				1.3.2.2	Social support	Very strong	Strong	Moderate	Weak	None
				1.3.2.3	Social identity	Very strong	Strong	Moderate	Weak	None
				1.3.2.4	Citizen participation	Very high	Strong	Moderate	Low	None
				1.3.2.5	Sense of community	Very high	Strong	Moderate	Low	None
				1.3.2.6	Attachment of place	Very high	Strong	Moderate	Low	None
		1.3.3	**Community competence**							
				1.3.3.1	Political stability	Very strong	Strong	Moderate	Weak	None
				1.3.3.2	Leadership skills	Very strong	Strong	Moderate	Weak	None
				1.3.3.3	Level of education	Very high	High	Moderate	Low	None
				1.3.3.4	Prior experience	Very high	High	Moderate	Low	None
				1.3.3.5	Community partnerships - external/internal	Very strong	Strong	Moderate	Weak	None
		1.3.4	**Information & communication**							
				1.3.4.1	Number of information sources	Very large number of sources	Many sources	Moderate number of sources	Few number of sources	None
				1.3.4.2	Public vs. expert perceptions	Public perceptions aligned with expert perceptions	Public perceptions somewhat aligned with expert perceptions	Public indifference to expert perceptions	Public perceptions somewhat aligned with expert perceptions	Public perceptions not at all aligned with expert perceptions
				1.3.4.3	Trusted sources of information	Yes				No
				1.3.4.4	Efficacy of risk messaging	Very effective	Effective	Neutral	Ineffective	Damaging
				1.4.4.5	Communication infrastructure	Very strong	Strong	Moderate	Weak	None

						SCALE				
						Less complex				**More complex**
						0	1	2	3	4
		1.3.5	**Other infrastructure**							
				1.3.5.1	Degree of interdependence re: cascading failures	Very low	Low	Moderate	High	Very high
				1.3.5.2	Presence of redundant systems	Very high	High	Moderate	Low	None
				1.3.5.3	Distribution networks / supply chains	Very high	High	Moderate	Low	None

Annex D   Three-way Analytic Grid

The draft actions described below are related to a potential cyber attack scenario.

			PROBLEM SOLVING STAGES					
			Problem Identification Awareness of issue Making assumptions Data gathering Agreement that issue exists Identification of potential impacts	**Problem Definition** Decomposing the issue Verifying assumptions Setting boundaries Root cause analysis Data interpretation Framing the problem	**Solution Generation** Developing options Evaluating options Prioritizing options	**Decision Making** Choosing an option Qualifying decision Communicating decision	**Solution Implementation** Committing to decision Assigning roles Assigning accountability Assigning resources	**Feedback: Success/Failure** Gathering data Monitoring consequences Changing plans Communicating changes Re-allocating resources
Approach	**Time**	**Assets**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**
Coordination	**Pre**	Information	Share standard EM plans	Share case studies of cyber-attacks	Consult other organizations when weighing options	Inform other organizations of decision	Practice standard EM plans	No
"A process of communication, planning and sharing of resources, risk and rewards for purposes of efficiency and effectiveness in achieving the complementary goals of the parties involved" (Taylor-Powell et al., 1998) Emphasis on: avoidance of duplication; efficiency of service, sharing primarily information, parallel activities, independent decision making.	(-3 to -2)	Activities/ Resources	No	No	No	No	No	No
		Power/ Authority	No	No	No	No	No	No
	During	Information	Discuss news reports and other official info	Share possible anti-virus solutions	Organize own recall of systems, weigh options	Share possible viral solutions and recall plans with other orgs.	Begin recall, and offer their plan to other orgs.	Monitor amount of returned systems, and impact on virus
	(-1 to +1)	Activities/ Resources	No	No	No	No	No	No
		Power/ Authority	No	No	No	No	No	No
	Post	Information	Discuss how to prevent recurrence	Discuss lingering / latent issues	Create resiliency plan for future events	Effect a policy change for safer importing of computer parts	Install better anti-virus	Discuss lessons learned
	(+2 to +3)	Activities/ Resources	No	No	No	No	No	No
		Power/ Authority	No	No	No	No	No	No

			PROBLEM SOLVING STAGES					
			Problem Identification Awareness of issue Making assumptions Data gathering Agreement that issue exists Identification of potential impacts	**Problem Definition** Decomposing the issue Verifying assumptions Setting boundaries Root cause analysis Data interpretation Framing the problem	**Solution Generation** Developing options Evaluating options Prioritizing options	**Decision Making** Choosing an option Qualifying decision Communicating decision	**Solution Implementation** Committing to decision Assigning roles Assigning accountability Assigning resources	**Feedback: Success/Failure** Gathering data Monitoring consequences Changing plans Communicating changes Re-allocating resources
Approach	**Time**	**Assets**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**
Cooperation	**Pre**	Information	Share standard EM plans	Share case studies of cyber-attacks	No	No	Practice standard EM plans	No
"A process where parties with similar interests plan together, negotiate mutual roles, and share resources to achieve joint goals, but maintain separate identities (Taylor-Powell et al., 1998)." Emphasis on: coordinating existing resources, filling resource gaps, creating new organizations to fill gaps, greater sharing of information plus activities/resources, more interdependence (problem definition, solution implementation) more joint deciions making; able to achieve more than usual tasks - have greater impact	(-3 to -2)	Activities/ Resources	P-Ram Communi-cations Develops anti-virus software	Memorandum of Understanding / Creating Partnerships between orgs.	P-Ram Communications distributes anti-virus software	Asset map to assess possible gaps in essential services	Form Roundtable to share info, and practice plans, and to distribute anti-virus	No
		Power/ Authority	No	No	No	No	No	No
	During	Information	Shared expert opinions and data	Determine extent of effect	Create appropriate risk messaging	Choose trusted sources to deliver message	Hold a press conference	Discuss if medium was appropriate, reached entire target audience
	(-1 to +1)	Activities/ Resources	Contact other orgs via phone, email, fax, to collect their current data	Assess resource gaps	Discuss how resources are to be deployed / shared	P-RAM IT technicians to go onsite, to collect systems, effect anti-virus repairs	Coordinate efforts between orgs. for solution delivery	Did technicians reach target groups? Discuss possible shortcomings
		Power/ Authority	No	No	No	No	No	No
	Post	Information	Discuss possible recurrence	Discuss lingering / latent issues	Create resiliency plan for future events	Effect a policy change for safer importing of computer parts	Install better anti-virus	Town hall meeting to discuss results and seek input for future policy changes
	(+2 to +3)	Activities/ Resources	How many systems need to be rebuilt?	Possible short term solutions?	Reconstruction of corporate systems	Who will pay for the replacement systems? Who will do the work?	Coordination of comprehensive recovery and reconstruction plan	Conduct or fund studies to monitor interventions at the recovery / reconstruction stages
		Power/ Authority	No	No	No	No	No	No

			PROBLEM SOLVING STAGES					
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Approach	**Time**	**Assets**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**
Collaboration	**Pre**	Information	Social Media / Internet Surveillance early warning systems	Flexible interpretive framework used / problems not defined by assets available	Wide variety of stakeholders included in solution generation	Decision making conducted in a transparent manner	Plans shared and roles clarified with all interested parties	No
"A process through which parties who see different aspects of the problem can explore constructively their differences and search for (and implement) solutions that go beyond their own limited vision of what is possible" (Taylor-Powell et al., 1998). Emphasis on:shared responsibility and a greater inter dependency; shared vision with partitioned mandates; voluntary participation and consent; multiple perspectives (inclusive); shared products and credit.(Taylor-Powell & Rossing, 2009)	(-3 to -2)	Activities/ Resources	Skills inventory created to determine assets ahead of time	Structural weakness identified by looking at the issues / gaps holistically	At-risk populations considered when prioritizing options	Option chosen based on projected needs rather than immediately available resources	Memorandums of understanding used to outline roles	No
		Power/ Authority	Issues determined through verifiable evidence	Creation of shared vision among multi-stakeholders	Priorities based on local knowledge / evidence / deferral to experts	Public consultation in decision making process	Final decisions elicit public trust	No
	During	Information	Information shared with other concerned organizations in a transparent manner (within security constraints)	Flexible interpretive framework used / looking at the problem from different perspectives	Utilize crowd sourcing technology to make sense out of data quickly	Effective risk messaging (early and often)	Combined expertise from public and private sector to deliver message	No fault reporting used to gain knowledge from the ground up on intervention efficacy
	(-1 to +1)	Activities/ Resources	Examine data with experts from several different fields of IT and EM	Determine the flow and amount of data to be process in relation to available man-power	Consider the possible networks in the community (i.e./ phone trees, university computer labs)	Contact the identified organizations, and have them begin processing data	Utilizing emergent organizations and crowd sourced possibilities for virus control	Use analytics to determine rate of public involvement
		Power/ Authority	Convene heads of private IT sector and government officials	Discuss the range of damage / municipal / provincial / federal	Decide which systems need to be dealt with first (ie. hospital a priority)	Decisions determined by local needs	Improvisation used in establishing a governing framework for the mass recall	Speed and ease of decision making cycle determines success of shared authority structure
	Post	Information	Data gathered from affected populations	Flexible interpretive framework used / looking at the problem from different perspectives	Establish a set meeting time for possible exercises and drills amongst all the identified orgs.	Contact the identified organizations with monthly updates	Hold drills, meetings, roundtables and exercises	Evaluate the possible success or failure of the shared information amongst many levels of government and private sector

			PROBLEM SOLVING STAGES					
			Problem Identification Awareness of issue Making assumptions Data gathering Agreement that issue exists Identification of potential impacts	**Problem Definition** Decomposing the issue Verifying assumptions Setting boundaries Root cause analysis Data interpretation Framing the problem	**Solution Generation** Developing options Evaluating options Prioritizing options	**Decision Making** Choosing an option Qualifying decision Communicating decision	**Solution Implementation** Committing to decision Assigning roles Assigning accountability Assigning resources	**Feedback: Success/Failure** Gathering data Monitoring consequences Changing plans Communicating changes Re-allocating resources
Approach	**Time**	**Assets**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**	**Actions Demonstrating Asset Sharing**
	(+2 to +3)	Activities/ Resources	Examine data regarding networked systems and their speed and ease of use during the event	Define how these networks, antiviruses and firewalls can be expanded, better utilized	Use the emergent groups presented during the impact phase to help strengthen the network	Contact the organizations, and the public. Invite them to join the effort of increased security	Create a joint task force for future events	Appoint board of governors to assess efficacy.
		Power/ Authority	Examine information regarding the shared scope of effects and responsibilities	Consider, can the public be both victim and rescuer in a cyber-attack?	Public engaged in the solution generating process (community leaders brought to the table)	Public consultation in decision making process	Resources allocated according to local needs	Share blame / success

Annex E Considerations for Dependent Variables – Problem Solving Processes and Outcomes

Problem Solving Processes

Variable Name	Considerations	Type of Measure & Frequency	Required Actions

Satisfaction with problem solving process	• Need to ensure that this is separate from problem solving outcome (e.g., decision) – emphasize the process
	• Bi-directional Likert-type scale with well anchored ends
	• Very Dissatisfied, Dissatisfied, Neutral, Satisfied, Very Satisfied
	• Key components would include satisfaction with:
	  • overall process
	  • time required
	  • participation from team
	  • opportunities for you to provide input
	  • difficulty of task
	  • information/instructions received
		• Self report (pen and paper)
		• Quick measure of key components after each task if possible (2X) (in-session)
		• One overall for session (debrief)
			Will need to develop in-house:
			• Self report measure

Level of participation (intra-pod)	Would be rated on a number of components.
	• Pattern, total & proportion of minutes talking by individual
	• Pattern, total & proportion of minutes individual is engaged with group (talking or active listening)
	• Pattern, total & proportion of minutes of individual is disengaged from (independent work, reading)
	• Pattern, total & proportion of solicited suggestions/ideas/alternatives provided by individual
	• Pattern, total & proportion of unsolicited suggestions/ideas/alternatives provided by individual
	• Self ratings on participation (engagement, alternatives generated)
	• Participation ratings from other pod members (engagement, idea generation)
		• time coding via audio/video (post session)
		• content coding transcripts/audio/video (post session)
		• participation ratings – self report and other report (in session after each task if possible (2X) and at debrief)
			Will need to develop in-house:
			• process for time coding
			• content coding scheme
			  • engagement
			  • disengagement
			  • idea/alternative generation
			• self and other measure

Variable Name	Considerations	Type of Measure & Frequency	Required Actions
Level of participation (inter-pod)	Would be rated on a number of components: • Ratio of minutes spent on *intra*-pod communication vs. *inter*-pod communication • Total & proportions of intra-pod communication by problem solving stage and by problem solving approach.	• time coding via audio/video (post session)	Will need to develop in-house: • process for time coding
Time spent on problem solving stages	• elapsed time (minutes) and proportion total time from task start to production of problem definition product • elapsed time (minutes) and proportion total time from problem definition product to solution generation product • elapsed time (minutes) and proportion total time from solution generation product to decision-making product	• time coding via audio/video (post session)	Will need to develop in-house: • process for time coding • demarcation of product completion criteria

Pattern of engagement in problem solving stages	• pattern of time spent on problem definition activity within overall task (minutes distributed across timeline)
	• pattern of time spent on solution generation activity within overall task (minutes distributed across timeline)
	• pattern of time spent on decision making activity within overall task (minutes distributed across timeline)
	• proportion of inter-pod communication by problem solving activity type
		• time coding via audio/video (post session)
		• content coding transcripts/audio/video (post session)
			Will need to develop in-house:
			• process for time coding
			• content coding scheme
			    • problem definition activity
			    • solution generation activity
			    • decision making activity

Intra pod task and group cohesion	Intra pod task cohesion would be measured on concepts of: • degree to which pod was task oriented (Zaccaro, 1995) • importance that the pod perform well (Zaccaro, 1995) • motivation to work hard so pod succeeds (Zaccaro, 1995) • importance that other members perform well on the task (Zaccaro, 1995) Intra pod group cohesion would be measured on concepts of: • sense of belonging to pod (Chin, 1999)	• self report measures based on previous measures in this area • participation ratings – self report (in session after each task if possible (2X) and at debrief)	Will need to adapt measures for: • task cohesion (Zaccaro, 1995) • group cohesion (Chin, 1999)

Variable Name	Considerations	Type of Measure & Frequency	Required Actions
	• sense of pod morale (Chin, 1999)		
Inter pod task and group cohesion	Task cohesion would be measured on concepts of: • degree to which group of pods were task oriented (Zaccaro, 1995) • importance that the group of pods perform well (Zaccaro, 1995) • motivation to work hard so the group of pods succeed (Zaccaro, 1995) • importance that other pods perform well on the task Inter pod group cohesion (Zaccaro, 1995) • sense of belonging to group of pods (Chin, 1999) • sense of group of pods morale (Chin, 1999)	• self report measures based on previous measures in this area • participation ratings – self report (in session after each task if possible (2X) and at debrief)	Will need to adapt measures for: • task cohesion (Zaccaro, 1995) • group cohesion (Chin, 1999)

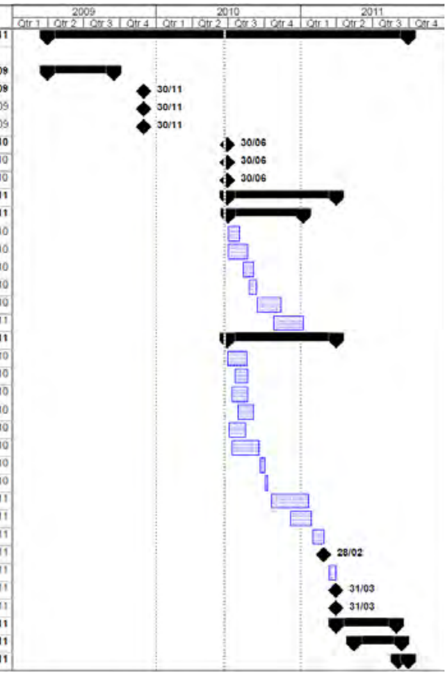
Problem Solving Outcomes

Variable Name	Considerations	Type of Measure & Frequency	Required Actions
Decision quality	Would be rated on a number of components including that the decision has considered: • impacts of event on multiple tiers • impacts of implementing solutions on multiple tiers • psychosocial implications of event • psychosocial implications of implementing solutions • general resource constraints/availability • specialized resources required • time requirements Would be rated on the extent to which the decision: • reflects multiple perspectives from within the pod • reflects multiple perspectives from outside the pod • has innovative/creative characteristics • presents a cohesive approach (*not just every member's solutions piled together*) • shares information • shares resources • shares power/authority • has significant operational gaps/challenges • has significant strategic gaps/challenges	• content coding transcripts / audio / video (post session) • judges' ratings	Will need to develop in-house: • content coding scheme for all dimensions outlined • template for presenting synopsis of decision • rating guide for judging decision quality
Satisfaction with problem solving outcome	• Need to ensure that this is separate from problem solving process – emphasize the outcome Key components would include satisfaction with: • the overall quality of the outcome • the extent to which outcome reflects the input from pod members • the likelihood that this could be implemented successfully • the likelihood that this would address the main problems	• Self report (pen and paper) • Quick measure of key components after each task if possible (2X) (in-session) • One overall for session (debrief)	Will need to develop in-house: • Self report measure

Variable Name	Considerations	Type of Measure & Frequency	Required Actions
Level of agreement	Would include: • Self rated level of agreement with outcome • Observed level of agreement among pod members	• Self report (pen and paper) • Quick measure of key components after each task if possible (2X) (in-session) • One overall for session (debrief) • content coding transcripts/audio/video (post session)	Will need to develop in-house: • self report measure • content coding scheme for level of agreement
Changes in individual organizational goals	Would include: • Statement of individual organizational goals at problem definition stage • Statement of individual organization goals post-task	• Statement and restatement of individual goals would need to be built in to task instructions; • content coding of task outcomes to determine extent to which individual org goals changed	Will need to develop in-house: • tasks that can include statements of individual organization goals at the problem definition stage • content coding scheme for assessing goal change
Changes in collective goals	Would include: • Statement of collective goals during problem definition stage • Statement of collective goals post-task	• Statement and restatement of collective goals would need to be built in to task instructions; • content coding of task outcomes to determine extent to which collective org goals changed	Will need to develop in-house: • tasks that can include statements of collective organization goals at the problem definition stage • content coding scheme for assessing goal change

Annex F Project Schedule

ID		Task Name	Start	Finish
1		**Researh Using IN VIVO Simulation, June 21, 2010pb**	**Wed 01/04/09**	**Fri 30/09/11**
2				
3		**WO Project start-up and management**	**Wed 01/04/09**	**Wed 16/09/09**
8	✓	**W1 Synthesis of case studies to form a SDM framework**	**Mon 30/11/09**	**Mon 30/11/09**
9	✓	**M1 Synthesis of case studies to form a SDM framework**	Mon 30/11/09	Mon 30/11/09
10	✓	**D1 Research report summarizing SDM framework and documents case studies**	Mon 30/11/09	Mon 30/11/09
11	✓	**W2 Development of tools for IN VIVO exercise and simulation**	**Wed 30/06/10**	**Wed 30/06/10**
12	✓	**M2 Development of tools for IN VIVO exercise and simulation**	Wed 30/06/10	Wed 30/06/10
13	✓	**D2 Reserch report re: in vivo lab experimental plan to simulate emergency response dec**	Wed 30/06/10	Wed 30/06/10
14		**W3 Testing of SDM framework in vivo using simulation**	**Wed 30/06/10**	**Thu 31/03/11**
15		**Component 1: Qualitative Interviews**	**Fri 02/07/10**	**Fri 07/01/11**
16		Finalize interview guide	Fri 02/07/10	Fri 30/07/10
17		Prepare submission & obtain ethics approval	Fri 02/07/10	Fri 20/08/10
18		Identify/select participants	Mon 09/08/10	Fri 03/09/10
19		Test interview process/instruments	Mon 23/08/10	Fri 10/09/10
20		Conduct interviews	Mon 13/09/10	Fri 12/11/10
21		Collate/analyze results	Mon 25/10/10	Fri 07/01/11
22		**Component 2: Experiment**	**Wed 30/06/10**	**Thu 31/03/11**
23		Develop / calibrate scenarios	Wed 30/06/10	Tue 17/08/10
24		Develop / calibrate problem solving approach tasks	Mon 19/07/10	Fri 20/08/10
25		Finalize measures for problem solving processes & outcomes	Mon 12/07/10	Fri 20/08/10
26		Develop detailed study protocols	Mon 26/07/10	Fri 03/09/10
27		Prepare submission & obtain ethics approval	Mon 05/07/10	Fri 13/08/10
28		Obtain, set-up and test equipment & facilities	Mon 12/07/10	Fri 17/09/10
29		Train technical staff, facilitators, observers	Mon 20/09/10	Fri 01/10/10
30		Pilot test study environment & processes	Mon 04/10/10	Fri 08/10/10
31		Launch experiment	Mon 18/10/10	Fri 21/01/11
32		Collate/analyze results	Mon 06/12/10	Fri 28/01/11
33		Draft report on findings: Qualitative Interviews & Experiment	Tue 01/02/11	Mon 28/02/11
34		Submit for review to TA (MS Word/PDF)	Mon 28/02/11	Mon 28/02/11
35		Prepare final report (electronic + hard copy-5)	Mon 14/03/11	Thu 31/03/11
36		**M3 Testing of SDM framework in vivo using simulation**	Thu 31/03/11	Thu 31/03/11
37		**D3 Research report summarizing results of lab investigations**	Thu 31/03/11	Thu 31/03/11
38		**W4 Modeling of communication and decision functions**	**Fri 01/04/11**	**Wed 31/08/11**
47		**W5 User friendly knowledge tool**	**Mon 16/05/11**	**Mon 12/09/11**
58		**W6 Project results dissemination and closeout**	**Mon 05/09/11**	**Fri 30/09/11**



List of symbols/abbreviations/acronyms/initialisms

ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
CBRNe	Chemical, Biological, Radiological, Nuclear, Explosive
CEO	Chief Executive Officer
CF	Canadian Forces
CORA	Centre for Operational Research and Analysis
CRTI	Chemical, Biological, Radiological, Nuclear and Explosives Research and Technology Initiative
CSS	Centre for Security Sciences
D1	Deliverable 1
D2	Deliverable 2
D3	Deliverable 3
DRDC	Defence Research & Development Canada
DRDKIM	Director Research and Development Knowledge and Information Management
EM	Emergency Management
EMO	Emergency Measures Organization
EOC	Emergency Operations Centre
FC	Forces canadiennes
FEMA	Federal Emergency Management Agency
GAP	Groupe d'Analyse Psychosociale
I	ICS
IBM	International Business Machines
ICS	Incident Command System
IT	Information Technology
M	Military
MANCOVA	Multivariate Analysis of Covariance
MANOVA	Multivariate Analysis of Variance
M1	Milestone 1
M2	Milestone 2
M3	Milestone 3
MS	Microsoft
NGO	Non-governmental Organization

NI	Non-Incident Command System
NIMS	National Incident Management System
Non-ICS	Non-Incident Command System
ORG	Organization
PDF	Portable Document Format
PRiMer	Psychosocial Risk Manager
R&D	Research & Development
RCMP	Royal Canadian Mounted Police
SARS	Severe Acute Respiratory Syndrome
SDM	Shared Decision Making
TA	Technical Authority
TIF	Technology Innovation Fund
TCPS	Tri-Council Policy Statement
WO	Work Order
W1	Work Package 1
W2	Work Package 2
W3	Work Package 3
W4	Work Package 4
W5	Work Package 5
W6	Work Package 6

DOCUMENT CONTROL DATA

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13. ABSTRACT (A brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (S), (C), (R), or (U). It is not necessary to include here abstracts in both official languages unless the text is bilingual.)

Introduction or background: This report represents Task 2 of the work stream "Research Using in Vivo Simulation of Meta-Organizational Shared Decision Making (SDM)", one component of the Technology Innovation Fund (TIF) program on Meta-organizational Collaboration that has been designed to assist in understanding challenges faced by the Canadian Forces (CF). The objective of the stream is to conduct basic research into shared decision making through the analysis of case studies, exercises and simulations.

Method: This task2 involved the development of an experimental plan to simulate an *in vivo* decision making environment of emergency management operations and to collect data on the problem solving processes and outcomes of participants in the simulation.

Results and Discussion: Based on the *Model for Inter-organizational Problem Solving* developed in Task 1, the experimental plan presents several research questions related to the impact that intra-organizational environment has on the ability to problem solve collaboratively, and, to the impact that collaboration has on improving problem solving outcomes and processes. The plan outlines two research components: 1) Qualitative analyses to identify features and cognitive structures/patterns that guide decisions about extreme events; 2) In vivo simulation of a complex event using a mix of organization types and participants.

Introduction : Ce rapport présente la Tâche 2 du projet « Recherche par la simulation in-vivo sur la prise de décision partagée des méta-organisations », une composante du programme de recherche sur les méta-organisations financé par le Fond pour l'innovation technologique (Technology Innovation Fund – TIF), mis en place afin d'améliorer la compréhension des défis auxquels font face les Forces canadiennes (FC) en matière de collaboration inter-organisationnelle. L'objectif de ce projet est de mener une recherche fondamentale sur la prise de décision partagée, au moyen d'études de cas, d'exercices et de simulations.

Méthode : La Tâche 2 a impliqué le développement d'un plan expérimental afin de simuler un environnement sur la prise de décision partagée in-vivo des opérations de gestion des urgences et pour colliger des données portant sur les processus de résolution de problèmes et les performances des participants dans cette simulation.

Résultats et discussion : Basé sur le *Modèle pour la résolution inter-organisationnelle des problèmes*, développé en Tâche 1, le plan expérimental teste des questions de recherche liées à l'impact que l'environnement intra-organisationnel a sur la capacité de résoudre des problèmes en collaboration. Le plan décrit deux composantes de recherche : 1) Des analyses qualitatives afin d'identifier des caractéristiques et des structures ou modèles mentaux qui guident les décisions lors d'événements extrêmes; 2) La simulation in-vivo d'un événement extrême en utilisant des configurations particulières d'environnement selon les types d'organisations et de participants.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (Technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model

designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

Inter-organizational; collaboration; cooperation; coordination; decision making; problem solving; complex situations; TIF; meta-organization